Vaisala HydroMet™ System MAWS301

USER'S GUIDE

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CHAPTER 1

GENERAL INFORMATION

This chapter provides general notes for the product and this manual.

About This Manual

This manual provides information for Vaisala HydroMet™ System MAWS301 equipped with meteorological and/or hydrological sensors.

Contents of This Manual

This manual consists of the following chapters:

- Chapter 1, General Information: This chapter provides general notes for the product and this manual.
- Chapter 2, Product Overview: This chapter introduces the features, accessories, sensors, and the product nomenclature.
- Chapter 3, Operation: This chapter provides the instructions for taking MAWS into use when all the equipment has been assembled and installed, as well as operating instructions for the MAWS Terminal software.
- Chapter 4, Maintenance: This chapter provides information that is needed in the basic maintenance of MAWS, sensors, and accessories.
- Chapter 5, Troubleshooting: This section consists of some common MAWS problems, their probable causes, and remedies.

- Appendix A, Glossary: This appendix contains glossary with explanations of some general meteorological and technical terms and terms used in specifications.

Safety

General Safety Considerations

Throughout the manual, important safety considerations are highlighted as follows:

WARNING	Warning alerts you to a serious hazard. If you do not read and follow instructions very carefully at this point, there is a risk of injury or even death.

CAUTION	Caution warns you of a potential hazard. If you do not read and follow instructions carefully at this point, the product could be damaged or important data could be lost.

NOTE	Note highlights important information on using the product.

Product Related Safety Precautions

MAWS has been tested for safety and approved as shipped from the factory. The following safety precautions are not related to any specific procedures and therefore do not appear elsewhere in this manual. They are recommended precautions that personnel must understand and apply during different phases of operation and maintenance.

WARNING	Keep away from live circuits. Operating personnel must observe safety regulations at all times. Component replacement or internal adjustments must be made by qualified maintenance personnel. Do not replace components with the power cable connected. Under certain conditions, dangerous voltages may exist for some time even with the power cable disconnected. To avoid injuries, disconnect power and discharge circuits before touching them.

WARNING Do not service alone. Under no circumstances should any person reach into parts and assemblies that are mains powered and alive, for the purpose of servicing, except in the presence of someone who is capable of rendering aid.

WARNING Personnel working with or near high voltages should be familiar with modern methods of resuscitation.

WARNING Do not service a live system outdoors. Do not open units outdoors when the enclosure contains line voltage levels.

WARNING Do not operate in an explosive atmosphere, for example, when flammable gases or fumes are present. Operation of any electrical instrument in such an environment constitutes a definite safety hazard.

WARNING Do not substitute parts or modify the instrument. Because of the danger of introducing additional hazards, do not install unsuitable parts in the instrument. Contact Vaisala or its authorized representative for repairs to ensure that safety features are maintained.

WARNING Be careful when erecting the mast. See that there are no power lines or other obstacles above the mast.

WARNING Secure the mast properly to prevent it from falling. Tighten all the adjustment screws securely.

CAUTION Do not make changes to the wiring. Incorrect wiring can damage the device and prevent it from operating correctly.

NOTE When disposing of old batteries, be sure to do so in accordance with all regulations applicable in your area.

ESD Protection

Electrostatic Discharge (ESD) can cause immediate or latent damage to electronic circuits. Vaisala products are adequately protected against ESD for their intended use. However, it is possible to damage the product by delivering electrostatic discharges when touching, removing, or inserting any objects inside the equipment housing.

To make sure you are not delivering high static voltages yourself:

- Handle ESD sensitive components on a properly grounded and protected ESD workbench. When this is not possible, ground yourself with a wrist strap and a resistive connection cord to the equipment chassis before touching the boards. When neither of the above is possible, at least touch a conductive part of the equipment chassis with your other hand before touching the boards.
- Always hold the boards by the edges and avoid touching the component contacts.

Trademarks

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License Agreement

All rights to any software are held by Vaisala or third parties. The customer is allowed to use the software only to the extent that is provided by the applicable supply contract or Software License Agreement.

Warranty

For certain products Vaisala normally gives a limited one-year warranty. Please observe that any such warranty may not be valid in case of damage due to normal wear and tear, exceptional operating conditions, negligent handling or installation, or unauthorized modifications. Please see the applicable supply contract or Conditions of Sale for details of the warranty for each product.

CHAPTER 2

PRODUCT OVERVIEW

This chapter introduces the features, accessories, sensors, and the product nomenclature.

Vaisala HydroMet™ Systems include compact stations that can be used either with a portable tripod (MAWS201) or with pole masts of different heights in fixed installations (MAWS101 and MAWS301). The station comes with a set of sensors, that measure certain meteorological and/or hydrological quantities and that have been especially selected for use with Vaisala HydroMet™ Systems.

Vaisala HydroMet™ System MAWS301

Vaisala HydroMet™ System MAWS301 is a new generation AWS especially designed for applications where no commercial power or communication networks are present, or are too expensive to be installed. Due to its flexibility and economical design, MAWS301 is also an ideal choice for hydro meteorological and hydrological applications. The possibility to use the same and standard equipment for many different requirements lowers the cost of training, spare parts, and logistic support.

MAWS301 has been designed for applications where only a few sensors are required. However, MAWS301 can be easily upgraded, even in the field, to include a larger set of sensors including smart sensors such as ceilometer, visibility and present weather sensors, and water quality probes. The same basic system with its options and accessories can provide with all the needs of meteorological and

hydrological networks. The MAWS301 options are listed in Table 5 on page 15, Table 4 on page 15, and Table 3 on page 14.

The system setup is done using MAWS Lizard Setup Software. In addition, there are some generic sensor inputs in the Lizard software, allowing for limited flexibility to add new sensors to the system.

The system configuration can vary from small hydrological systems (see Figure 1 on page 12) to large integrated systems (see Figure 2 on page 13).

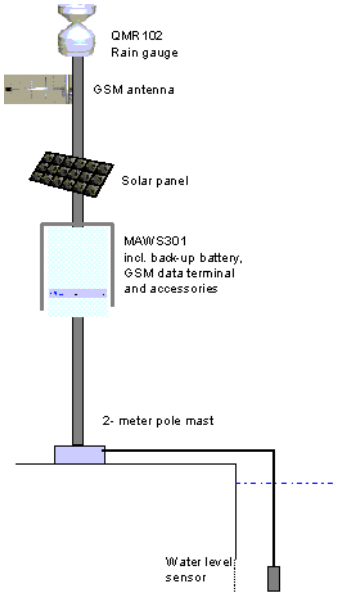


Figure 1 Hydrological System

MAWS301 is easy to install and maintain. All connections are made using pre-wired connections. The sensors are equipped with ready-made cables and connectors/glands for quick installation. All optional modules such as battery regulator, AC power supply, and surge arrestors are easily mounted on a DIN rail inside an enclosure.

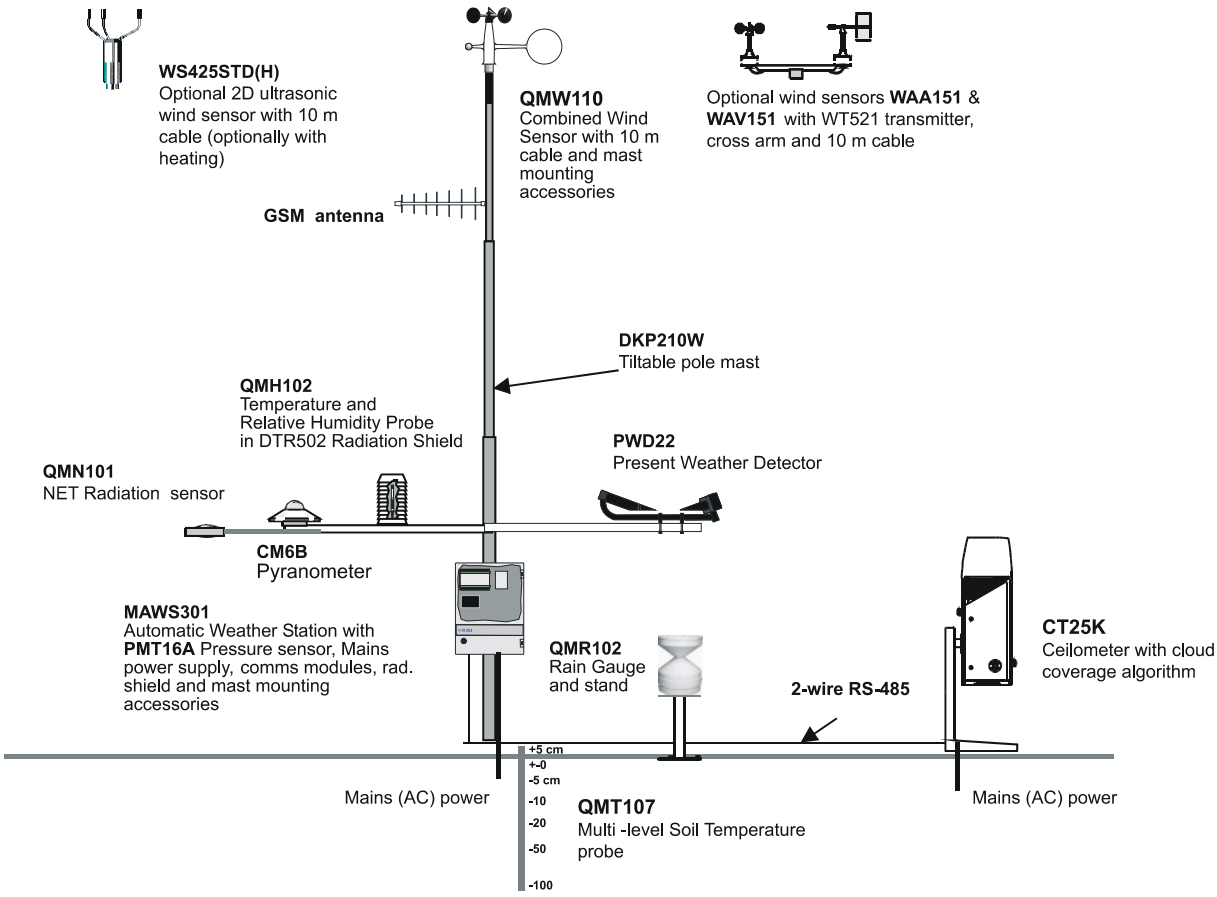


Figure 2 Integrated System

Product Nomenclature

The following tables provide the equipment nomenclature.

Table 1 MAWS301 Basic Set

Code	Common Name
MAWS Lizard	Setup software
MAWS Terminal	MAWS Terminal software
MAWS YourVIEW	Graphical Display Software (Basic version)
QBR101B	Battery regulator
QCD101	CD containing software and documentation
QML201	AWS Logger
ENC542PLM	Equipment enclosure

Table 2 Installation Accessories

Code	Common Name
DKP102	2-meter (6.6 ft.) pole mast
DKP12SUP1	Sensor support arm (half length)
DKP12SUP2	Sensor support arm (full length)
DKP060SUP1	Sensor support arm (half length)
DKP075SUP1	Sensor support arm (half length)
DKP202W	2-meter (6.6 ft.) pole mast
DKP203W	3-meter (10 ft.) pole mast
DKP204W	4-meter (13 ft.) pole mast
DKP206W	6-meter (20 ft.) pole mast
DKP210W	10-meter (33 ft.) pole mast
PLMLOCKSET	Two locks with keys for ENC542PLM
RG35003	Stand for QMR102 and RG13(H), total height with sensor 1.5 m (5 ft.)
RGB1	Base plate for QMR102, for installation on ground

Table 3 Optional Accessories

Code	Common Name
26588	32 MB Compact Flash memory card
MGP150	Mains power supply (for outdoor use)
QMBATT7	Backup battery, 12 V, 7 Ah
QMBATT12	Backup battery, 12 V, 12 Ah
QMBATT26	Backup battery set, 12 V, 26 Ah
QMBATT52	Backup battery set, 12 V, 52 Ah
QMD170	Handheld Display
QMD201, QMD202	Fixed Display/Keypad
QMG101	GPS Time synchronizing unit
QMI108	Digital I/O unit
SOLAR12	12 W solar panel
SOLAR24	24 W solar panel
WHP25	AC power supply for wind sensors
WT521	Digital wind transmitter

Table 4 Communication Options

Code	Common Name
DMX501	Modem module (fixed line)
DSI485A	RS-485 module (isolated)
DSI486	RS-485/RS-232/SDI-12 module (dual-isolated)
DSU232	RS-232 module (dual)
DXM421	PSTN modem
MC35	GSM data modem with GPRS functionality
TC35i	GSM data modem
INMARSAT-C	Inmarsat satellite transmitter set
SATEL3ASET-M3	Radio modem SATELLINE 3AS with accessories
QRC101	ORBCOMM Satellite transceiver set
QST102	GOES Satellite transmitter interface

Table 5 Sensor Options

Code	Common Name
CM11	Solar radiation sensor
CM6B	Solar radiation sensor
CM7B	Albedometer
CNR1	Net Radiometer
CT25K	Ceilometer
DCU7110	Water level sensor
DCU7210	Snow level sensor
DRD11A	Rain on/off sensor
DSU12	Sunshine duration sensor
DTR502	Radiation shield for HMP45
ECH2O-M3	Soil moisture sensor
FD12	Visibility sensor
FD12P	Present weather sensor
HMP45	Air temperature and relative humidity sensor
ML2x	Soil moisture sensor
PMT16A	Pressure sensor
PR36W	Water level sensor
PWD10	Visibility sensor
PWD12	Present weather detector
PWD20	Visibility sensor
PWD22	Present weather detector
QFM101	Fuel moisture sensor
QHB101	Bubbler water level sensor
QHR102	Radar water level sensor
QLW101	Leaf wetness sensor
QMH102	See HMP45
QMH110	See HMP45

Table 5 Sensor Options (Continued)

Code	Common Name
QMN101	Net solar radiation sensor
QMR102	Rain gauge (stand-alone)
QMS101	Global solar radiation sensor (photoed)
QMS102	Global solar radiation sensor (thermopile)
QMT103	Soil/water temperature sensor with 5 m (16 ft.) cable
QMT107	Soil Temperature Probe
QMT110	Soil/water temperature sensor with 10 m (33 ft.) cable
PR-36W	Water level sensor
QMW110	See WMS302
QSE101	Incremental shaft encoder
QSE103	Surfloat water level sensor
RG13	Rain gauge
RG13H	Heated rain gauge
T-200B	Weighing precipitation gauge
WAA151	Anemometer
WAA252	Heated anemometer
WAV151	Wind vane
WAV252	Heated wind vane
WMS302	Combined wind direction and speed sensor (referred to as QMW110)
WS425STD	Ultrasonic wind sensor
WS425STDH	Heated ultrasonic wind sensor

AWS Logger

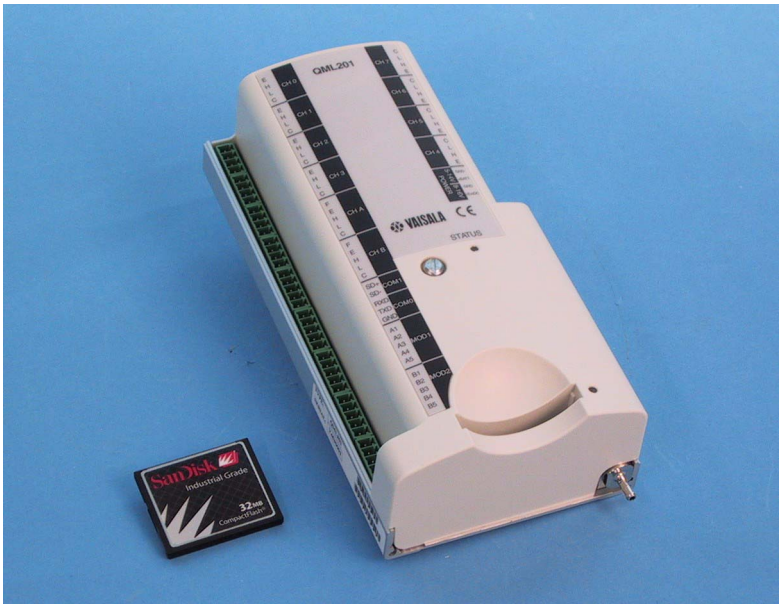


Figure 3 AWS Logger QML201

QML201 is a complete AWS logger designed on one printed board only. This board contains a 32-bit Motorola CPU for data processing and 10 differential (20 single ended) analog sensor inputs (these can also be used as digital inputs). Moreover, there are two frequency sensor interfaces, a 16 bit A/D converter, 1.7 Mb of secure Flash memory for data logging, as well as excitation power supply for sensors and charger for the internal backup battery. The last mentioned is not needed in the systems where a backup battery with higher capacity is used.

The board uses the latest SMD (Surface Mount Device) technology and is conformal coated for improved protection also in high humidity. Each sensor input has a varistor (VDR) protection against induced transients. The serial line connections, that is, RS-232 labeled as COM0 and RS-485 labeled as COM1, have two level ESD protection circuits with VDRs directly at input pins.

The cover of the logger can be removed for installing the battery and for resetting MAWS. In Figure 4 on page 18, the logger is shown without the cover and the optional communication modules.

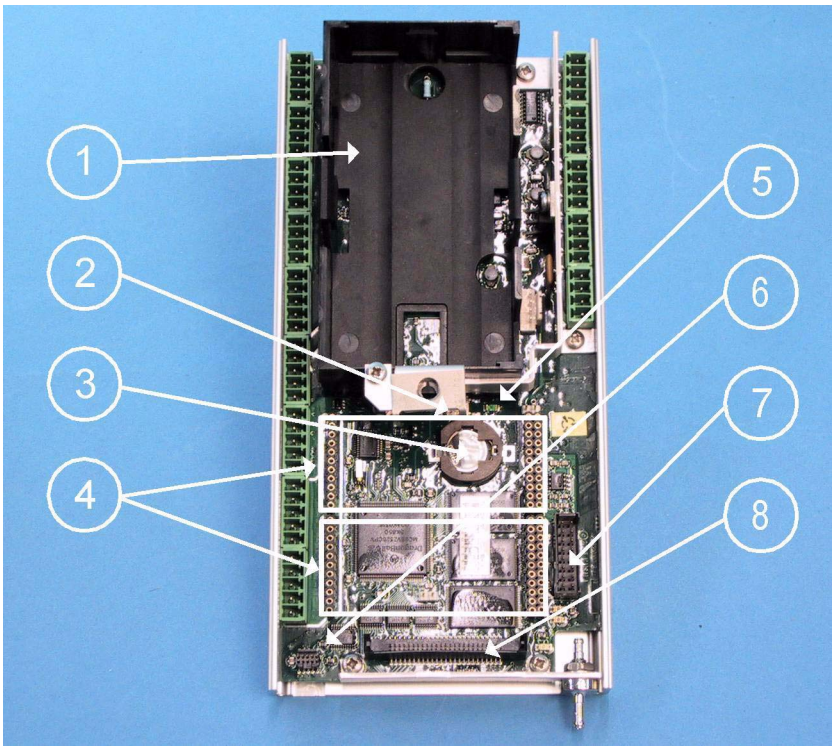


Figure 4 AWS Logger QML201 without Cover

The following numbers refer to Figure 4 on page 18:

1 = Place for the internal battery

2 = Reset button (under the bracket)

3 = Lithium battery for RTC

4 = Communication module places MOD1 and MOD2

5 = Status LED

6 = SPI connector

7 = Pressure sensor connector

8 = CF Card connector

When long signal cables are needed, these will be equipped with optional surge voltage protection devices. These surge arrestors consist of a combination of VDR, gas-filled discharge tube, transzorb diodes and coils, thus providing excellent protection. These DIN rail mountable devices are easy to change without any special tools.

The logger is equipped with CF card slot for logging a large amount of data. The data is logged into the daily files making it easy to locate any particular data set for further analysis. Currently there are cards available from 32 MB up to hundreds of MB. These cards can be read directly in the PC. Several different types of readers are commercially available: internal PCMCIA reader as well as external readers to be connected to USB or parallel port of a PC. Vaisala recommends the usage of industrial grade CF cards from Sandisk, that have been tested to function in harsh environments.

Figure 5 Compact Flash Memory Card Readers

Optional modules include, for example, various communication modules, and built-in pressure transducer.

MAWS is a low-power system. The logger consumes less than 10 mA from a 6 V battery (5 mA from a 12 V battery). MAWS can be powered using a solar panel or optionally using a 110/230 AC power supply. Also external DC supply (8 to 14 VDC recommended, 30 VDC max) can be used as the main power source for MAWS.

The power consumption of the complete MAWS system depends on the connected sensors, communication devices, and other options included in the delivery. For example, MAWS with basic set of 5 sensors, each having 10-minute measuring interval has an average power consumption of 10 mA / 6 VDC (5 mA / 12 VDC).

A Wall Adapter

A usual wall adapter (110/230 VAC, output min. 12 V/500 mA) can be used when the distance to the MAWS system is less than 100 m (328 ft.), provided that the wall adapter can be installed indoors.

NOTE	When the power cable resistance exceeds 10 Ω, a capacitor (from 100 to 200 μF, 40 V) should be added between GND and +ExtDC pins. Make sure that the polarity is correct.

MAWS Software

Operating Software

The embedded operating software runs in the AWS logger. Access to the operating software commands can be gained using the MAWS Terminal.

MAWS Terminal

MAWS Terminal is the terminal software for working with the MAWS stations. MAWS stations measure sensor data and store it in log files. With the MAWS Terminal software, you can download these files to your PC and view them.

When you start using MAWS, the first thing you need to do is to define what parameters you want to measure and at what frequency. You can do this by uploading a configuration file from your PC to the MAWS system.

MAWS Terminal is also used for setting the station specific parameters such as the station name, altitude, pressure sensor height, and sensor specific calibration coefficients. In addition, the date and time can be set using the easy-to-use MAWS Station Settings template.

After you have uploaded the configuration files to MAWS, you can browse the MAWS data files by downloading them from MAWS to your PC. You can browse them in MAWS Terminal or in other applications. You can define several download settings such as where

you want to save the downloaded files and what operations the program performs automatically at each download.

MAWS Lizard Setup Software

MAWS Lizard Setup Software is used to modify the software parameters and operation of the MAWS systems. With the MAWS Lizard software you can create or modify a setup file that informs MAWS how to operate.

Creating a setup with MAWS Lizard Setup Software consists of three stages. First, you define an assembly for the MAWS system. Then you define the necessary measurements and the calculations derived from them. Finally, you define reports and log groups from the measurement results.

The setup file on your PC is finally generated, in other words, converted into a format that MAWS understands, and then transferred into MAWS and taken into use.

Enclosure

Enclosure ENC542PLM is a polyester enclosure reinforced with fiberglass. This enclosure has space for the AWS logger, communication equipment, battery charger, and maintenance free lead-acid batteries of different sizes with the capacity up to 52 Ah. In addition, optional devices such as AC power supply and protective devices for communication lines can be installed inside the enclosure. All of the devices are installed on an easy-to-remove DIN-rail except the backup battery(ies), which is/are installed with a fixed-screw mounting clamp.

The enclosure material is highly resistant to corrosion, ultra-violet radiation, chemicals, and atmospheric agents. The enclosure is dust tight and sealed against water jets. The door sealing is ensured by using an extruded polyurethane foam gasket. The door is locked with a standard locking tool (lock with a key is available as an option).

Enclosure ENC542PLM has optionally a metal radiation shield painted white. This shield gives additional protection against excessive sunshine and falling material such as ice and tree branches.

In addition, the enclosure has a pressure compensation element installed at the bottom plate. This element compensates for varying degrees of pressure caused by the temperature differences. This membrane element together with high quality plastic material significantly reduces water condensation inside the enclosure.

For future needs, the enclosure has space reserved for optional devices. These can be mounted, for example, on the DIN-rail beneath the tiltable installation plate (number 3 in Figure 6 on page 22).

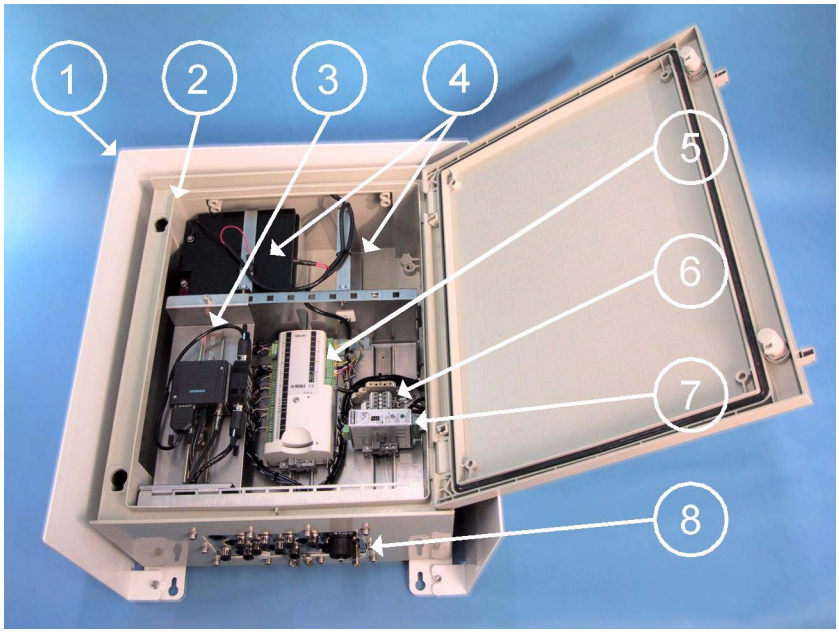


Figure 6 Enclosure ENC542PLM with Radiation Shield

The following numbers refer to Figure 6 on page 22:

1 = Radiation shield
2 = Enclosure
3 = Tiltable plate with DIN-rail
4 = Two places for the batteries
5 = Logger
6 = Terminal strip
7 = Battery regulator
8 = Connector flange

All sensors, power supply and communication devices are connected via environmentally sealed connectors to the equipment inside the enclosure. Each connector is identified individually with a label.

The atmospheric pressure sensor is located on the CPU board of the AWS Logger. On the enclosure there is a static pressure head for venting out the pressure sensor, thus minimizing the wind effect on the pressure measurement.

Accessories

Sensor Multiplexer

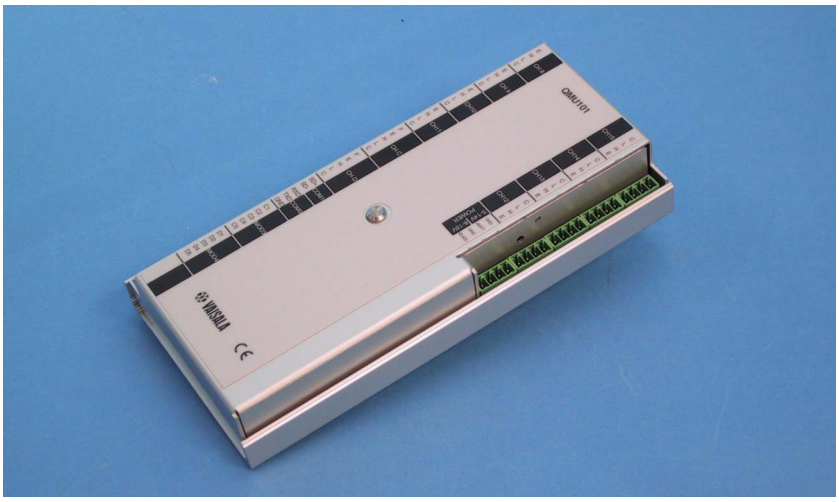


Figure 7 Sensor Multiplexer QMU101

The QML201 logger provides the possibility to extend the measuring capacity of MAWS with the optional Sensor Multiplexer QMU101. It is designed to increase the number of the analog measurement channels with eight 16-bit analog channels and two 12-bit analog channels. The module increases the measuring capacity with ten differential measurements or alternatively with 20 single-ended measurements.

The module interfaces to the logger via the RS-485 line. It is located inside the enclosure under the logger. The module conforms to the same environmental immunity and emission standards than the logger.

NOTE	The QMU101 module measures only analog measurements.

NOTE	The QMU101 module can only be connected to the QML201 logger. The type of the logger can be checked with the **VER** command. In MAWS Lizard Setup Software the QMU101 module is supported from MAWS software version 4.02 onwards.

Digital I/O Module

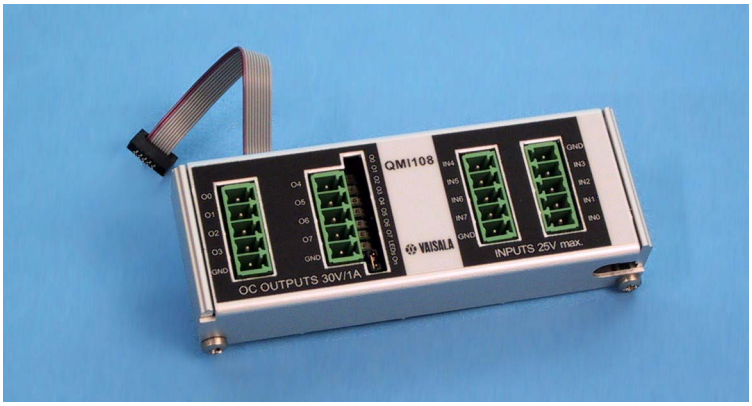


Figure 8 Digital I/O Module QMI108

The QML201 logger provides the possibility to extend the I/O capacity of MAWS with the optional Digital I/O Module QMI108 equipped with eight inputs and eight outputs. Digital I/O Module QMI108 interfaces to the logger via the SPI connector. The module is located inside the enclosure beside the logger, and it conforms to the same environmental immunity and emission standards than the logger.

The module has eight open collector outputs with 30 VDC / 1 A continuous drive capability and the LED indicators. The eight inputs of the module tolerate voltages from 0 to 25 VDC (the absolute maximum 30 VDC), and they have 40 ms (typical) contact debouncing circuitry.The module allows connection of slow pulse inputs, for example, with tipping bucket rain gauges.

NOTE	The QMI108 module can only be connected to the QML201 logger. The type of the logger can be checked with the **VER** command. In MAWS Lizard Setup Software the QMI108 module is supported from software version 4.00 onwards.

GPS Time Synchronizing Unit

Figure 9 GPS Time Synchronizing Unit QMG101

GPS Time Synchronizing Unit QMG101 is a GPS receiver with an embedded antenna for accurate time synchronization. MAWS software automatically reads the time from QMG101 and adjusts the RTC (Real Time Clock) if the difference is bigger than the user configurable maximum allowed. The default is 5 seconds. The unit is usually installed on the sensor support arm and interfaced via RS-232 with the logger. QMG101 is delivered with a 3 m cable, a connector, and installation accessories.

Masts

For equipment installation, there are 10-, 6-, 4-, 3-, and 2-meter masts available. For detailed product information, see appropriate manuals.

DKP206W and DKP210W are Tiltable Pole Masts, that is, they can easily be tilted up and down by one person when installing and maintaining the various devices on the mast. Also special attention has been paid to easiness and quickness of the mast installation. The DKP206W and DKP21W0 masts are made of anodized aluminum resisting well even the most harsh weather condition. The mast is equipped with a lightning rod and a set of guy wires. The height of the DKP206W masts is 6 m and that of the DKP210W masts is 10 m.

Figure 10 Mast DKP210W

DKP204W, DKP203W, and DKP202W are Short Pole Masts. They are designed for different kinds of weather station applications, such as, synoptical and climatological networks. The masts are made of anodized aluminum resisting well even the most harsh weather condition. The height of DKP204W is 4 m, DKP203W is 3 m, and DKP202W is 2 m.

Figure 11 Short Pole Masts

Sensor Support

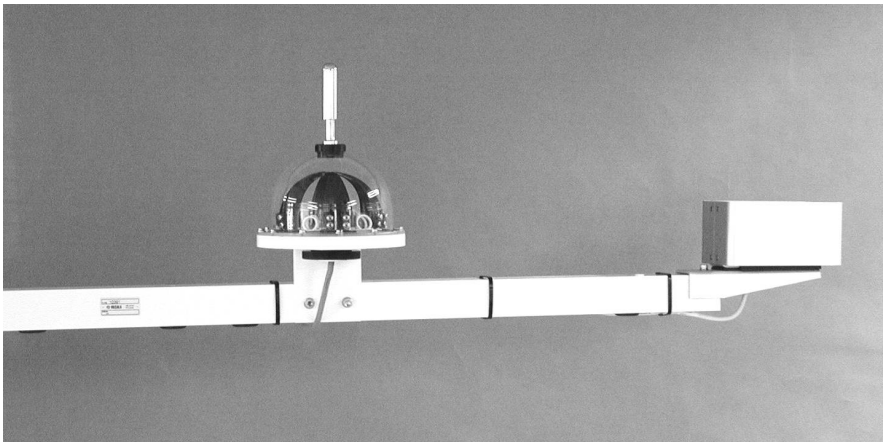


Figure 12 DSU12 and DRD11A Sensors Installed on Sensor Support

Certain sensors can be installed on a sensor support at the height of 1.5 to 2.0 meters (5 to 6.5 ft.) from the ground. The sensor support is

delivered with different kinds of brackets for installing to pole masts of different size.

AC (Mains) Power Supply

AC (Mains) Power Supply Unit MGP150 is a switching power supply, which operates from the universal AC (mains) input from 85 to 264 VAC and 50/60 Hz. The output voltage is 15 VDC, which is used for powering the AWS system, and as an input to the Battery Regulator for charging the back-up battery.

MGP150 is installed inside the AWS enclosure on a standard DIN- rail enabling easy maintenance of the unit.

Some sensors, such as the heated ultrasonic wind sensor, require higher DC voltage. In those installations, an additional mains power supply MGP360, a 36 VDC power supply module is installed.

Figure 13 AC (Mains) Power Supply MGP150

It is recommended to use the over voltage protection for the main input lines. The following mains power supply packages include also these surge arrestors for input lines as well as the necessary wiring inside the MAWS enclosures:

- MGP150-230-M3 for 230 VAC input
- MGP150-115-M3 for 115 VAC input

Transient Protection Devices

Each sensor input in the logger has a varistor (VDR) protection against induced transients. The maintenance terminal I/O port has transzorb diodes in their inputs.

In case of long signal cables, additional transient protectors can be installed on the DIN-rail. These surge arrestors consist of a combination of VDR, transzorb diodes, and coils, thus providing excellent protection.These are easy to change in the field without tools.

Figure 14 Surge Arrestor for Serial Lines

Optional coaxial surge arrestors will be used for UHF and VHF antennas as well as for the RF signal input when a radio or satellite equipment is used.

Figure 15 Surge Arrestors for AC (Mains) Power

Power Supply

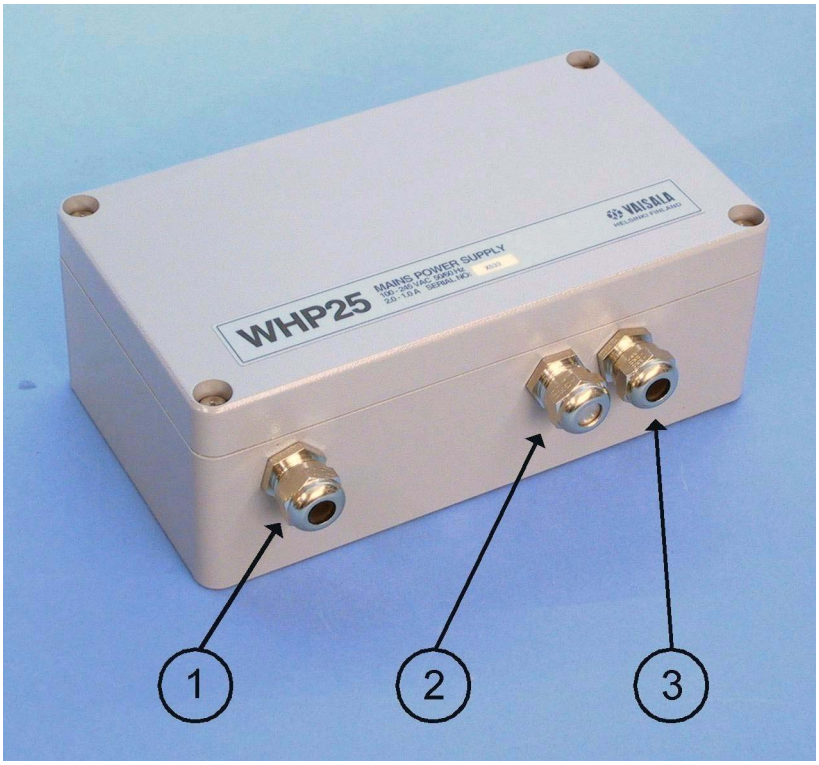


Figure 16 Mains Power Supply WHP25

The following numbers refer to Figure 16 on page 30:

1 = Gland for AC (mains) input cable

2 = Gland for optional power output cable

3 = Gland for power output cable

WHP25 is a compact AC (Mains) Power Supply Unit intended for outdoor use. The unit is capable of delivering power, for example, to the WA25 Wind Set.

The nominal input power of 230 VAC can be changed by jumpers between 100 VAC and 245 VAC (±10 %). The WHP25 unit provides two power outputs, namely 24.0 VDC (max 5.2 A) and 38.0 VAC (max 0.9 A).

The WHP25 unit has a waterproof housing made from cast aluminum. The mounting hardware is included in the delivery. It is mountable to a Ø 100 mm standard pole mast.

Solar Panels

SOLAR12-75

Figure 17 Solar Panel SOLAR12-75

The SOLAR12-75 solar panel is a custom-designed module incorporating high power efficiency, quality and ruggedness. The 12 W panel contains 36 polycrystalline silicon cells. The SOLAR12 modules have lightweight, high power and robust construction. The solar panel set includes a 6-meter cable and mounting accessories for a pole mast with a diameter between 75 and 100 mm.

SOLAR24

Figure 18 Solar Panel SOLAR24

SOLAR24 solar panels are custom-designed modules incorporating high power efficiency and quality. The 25 W panel contains 36 polycrystalline silicon cells. The SOLAR24 modules have lightweight, high power and robust construction. The solar panel set includes a 6-meter cable and mounting accessories for a pole mast with a diameter between 75 and 100 mm.

The cells are protected from dirt, moisture and mechanical impact using a tempered, low iron glass front. The solar circuit is laminated using EVA between tempered glass and a durable, multi-layered polymer back sheet for superior moisture resistance.

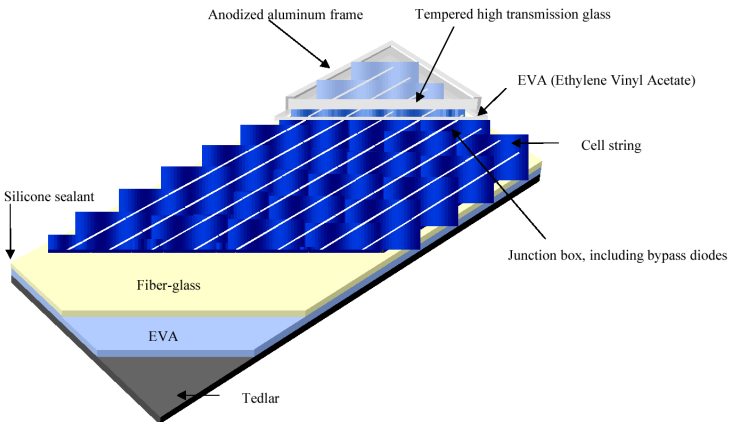


Figure 19 Solar Panel Layers

RS-232 Module

The RS-232 Communication Module DSU232 is an unisolated RS-232 module that will provide either a double serial channel without handshaking or a single RS-232 with handshaking. It has an ability to feed 12 V (45 mA) for the serial sensors. The power consumption is less than 15 mA when communicating, less than 5 mA at standby.

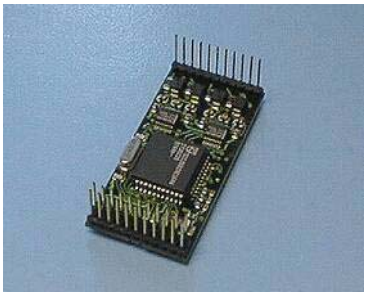


Figure 20 Communication Module DSU232

RS-485 Modules

Introduction to DSI485A

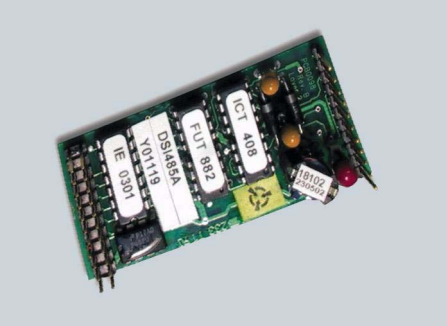


Figure 21 Isolated Communication Module DSI485A

DSI485A is an isolated communication module for providing the 2-wire or 4-wire RS-485-communication link between two devices with a similar interface. The DSI485A module is used, for example, for connecting displays and terminals to the data logger when the distance is longer than 15 meters. The maximum distance for DSI485A is approximately 1500 meters at full speed. The DSI485A module must be configured before using it in order to work as desired.

Introduction to DSI486

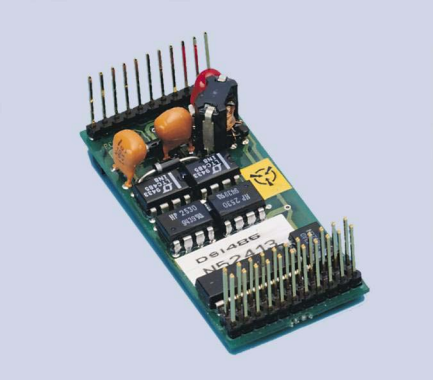


Figure 22 Dual-Isolated Communication Module DSI486

DSI486 is a dual-isolated communication module, which can be used in the RS-232, RS-485, or SDI-12 mode. The communication mode is selected by the correct wiring of the I/O pins and with the correct jumper settings on the board. The DSI486 module is used, for example, for connecting displays, terminals, and the data logger together when the distance is longer than 15 meters. The maximum distance for DSI486 is approximately 1500 meters at full speed. The DSI486 module must be configured before using it in order to work as desired.

The RS-485/422 channels A and B are galvanically isolated from the host board's electronics. The +5 VDC power supplies of channels A and B are also isolated from each other with capacitors. Thus, it is possible to wire these two channels to separate locations.

The RS-232 mode utilizes channel B. When channel B is used in the RS-232 mode, it is possible to use channel A as a galvanically isolated two-wire RS-485 channel. The RS-232 channel is galvanically connected to the host board's GND potential.

The SDI-12 channel has its own connecting point on the board. It does not use channel A or B for the communication. SDI-12 is galvanically connected to the host board's GND potential.

Modem Module

The DMX501 modem module is used for providing long distance fixed line connection between two Vaisala devices with a similar interface. It is used when the distance is up to 10 km, for example, between MAWS and Digital Display, or between Ceilometer CT25K and MAWS. Through this I/O port, a remote location can send reports and data or the host can poll them. The DMX501 modem module must be configured before using it so that it works as desired.

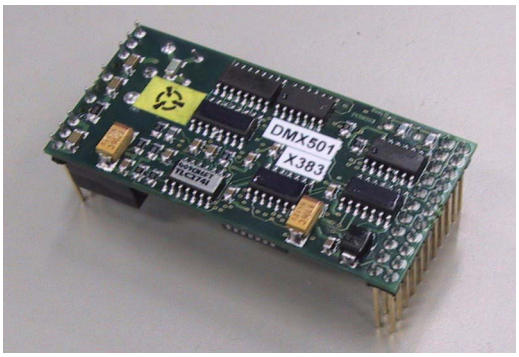


Figure 23 Modem Module DMX501

The DMX501 modem module supports the following communication standards:

- V.21, 300 bps FSK
- V.23, 1200 / 75 bps FSK
- V.22, 1200 bps DPSK

PSTN Modem

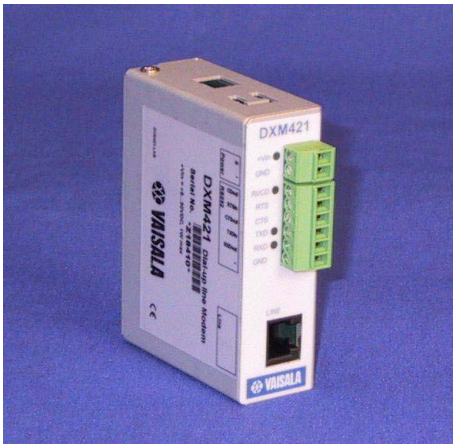


Figure 24 PSTN Modem DXM421

The DXM421 modem is an industrial hardened modem for Public Switched Telephone Networks (PSTN). It has been designed for demanding environments. It is rated for - 40 to +60 °C operating temperatures. The modem is mounted on a DIN trail inside the

equipment enclosure. The modem is DC-powered and has low power consumption.

DXM421 includes both data compression and data correction functions. The maximum data rate is up to 57.6 Kbits/second. The line input is protected by telecom PTC-fuse, sidactors and heavy duty 350 V discharge tube.

GSM Terminal Module

GSM Terminal TC35i has been especially designed for demanding professional use. It is the solution for quick and easy integration. Standard industrial interfaces, dual-band, and an integrated SIM card reader make it the ideal GSM terminal for universal use in voice/data communication.

Figure 25 GSM Terminal TC35i

MC35 is a GSM Terminal with the GPRS (General Packet Radio Service) capability. When used together with the iConnector module, it offers a wireless TCP/IP connection to send data via Internet.

Figure 26 GSM Terminal MC35

iConnector iC101 is a small adapter that enables installed devices to use the Internet for messaging via wireless modems and data-enabled phones that operate over AMPS, CDMA, CDPD, GPRS, GSM, iDEN, and TDMA wireless networks. iConnector provides "Instant Internet™" connectivity by eliminating the need for any hardware modification to a host device when connecting it to an Internet Service Provider (ISP). iConnector supports, for example, FTP client basic features and enables the user to communicate with the server using the FTP protocol.

The GSM antenna that is used with the GSM data modems is a directional antenna. The antenna provides high gain, enabling the data communication even in remote and sparsely populated installation sites where long distances or the terrain causes uncertain connections.In addition to giving a good connection, a strong signal also reduces the power consumption at the station.

The antenna cable is high quality coaxial cable. The radio modem is protected against high voltages using a surge arrestor installed on the antenna cable input.

Figure 27 GSM Antenna

UHF Radio Modem

Figure 28 Radio Modem SATELLINE 3AS

The SATELLINE 3AS radio modem is a half-duplex radio modem suitable for high-speed data applications. This radio modem offers high speed data transmission up to 40 km Line-Of-Sight (LOS). As a UHF radio modem, it provides the data speeds 19200 bps at 25 kHz and 9600 bps at 12.5 kHz in the air. RS interface data speed is user selectable from 300 to 38400 bps. The connection between data logger and the radio modem is established by using RS-232.

The Epic model with its 10 W transmitter power, dual receivers with the Diversity Reception operation can have distance up to 60 km LOS. The output power is configurable from 0.1 W up to 10 W.

Figure 29 Radio Modem Satelline 3AS Epic with Optional Display

Repeater Function

Message Routing is a built-in feature in the SATELLINE-3AS modems, which makes it easier to build up a large radio modem network. Message Routing features a versatile radio protocol, which takes care of routing messages across a radio modem network. Only one radio channel is required even in large networks. Any radio modem in the network can act as a repeater and have a weather station interfaced as well. The repeater can also be chained allowing message transmission through several repeaters/weather stations.

Using the in-built functions in the Satelline 3AS radio modems, two different types of repeater operations can be built:

1. The weather station having the radio modem will function as a repeater for a group of other stations
2. The radio modem alone installed in an enclosure with proper powering can function as independent repeater for a group of weather stations.

UHF Antenna

The CompleTech antenna product range offers optimized antenna solution for every application and installation requirements. The product range includes omnidirectional antennas, dipoles, directional and crosspolarized yagi antennas, and directional and multidirectional stacked arrays to serve demanding telemetry needs.

All the electromechanics in the antenna are moulded in polyurethane foam and covered by insulating covers. This construction results in extremely good combination of lightness, durability, and environmental resistance. The effects of water, ice, snow, and pollutants on properties of the antenna are minimized.

Depending on installation site, its function and LOS distances, two different kind of antennas are normally used:

1. Directional antenna for stations having longer LOS. The directional antennas range from simple one element yagi to multi-element yagis and stacked yagis with increased gain.

Figure 30 Directional Antennas with Different Gains

2. Omnidirectional antenna for stations function as repeaters or having shorter LOS. Omnidirectional ground plane antennas are robust antennas with high gain and especially suitable for repeater sites.

Figure 31 Omnidirectional Antenna

ORBCOMM Satellite Transceiver Set

Vaisala has integrated the satellite communication media called ORBCOMM with the HydroMet systems, for example, MAWS. The Vaisala HydroMet™ Systems support operation with the Panasonic KX-67101 transceiver. The ORBCOMM system uses Low-Earth-Orbiting (LEO) satellite, enabling the use of low power and small antenna in the transmitter terminals.

The ORBCOMM transmitters offer a low cost and robust way of transmitting data from remote sites almost in real-time. There is no need to install costly direct ground receiving stations. The local ORBCOMM operators offer the service where the data is transmitted to the users via Internet or dedicated lines directly from their Gateway Earth Stations.

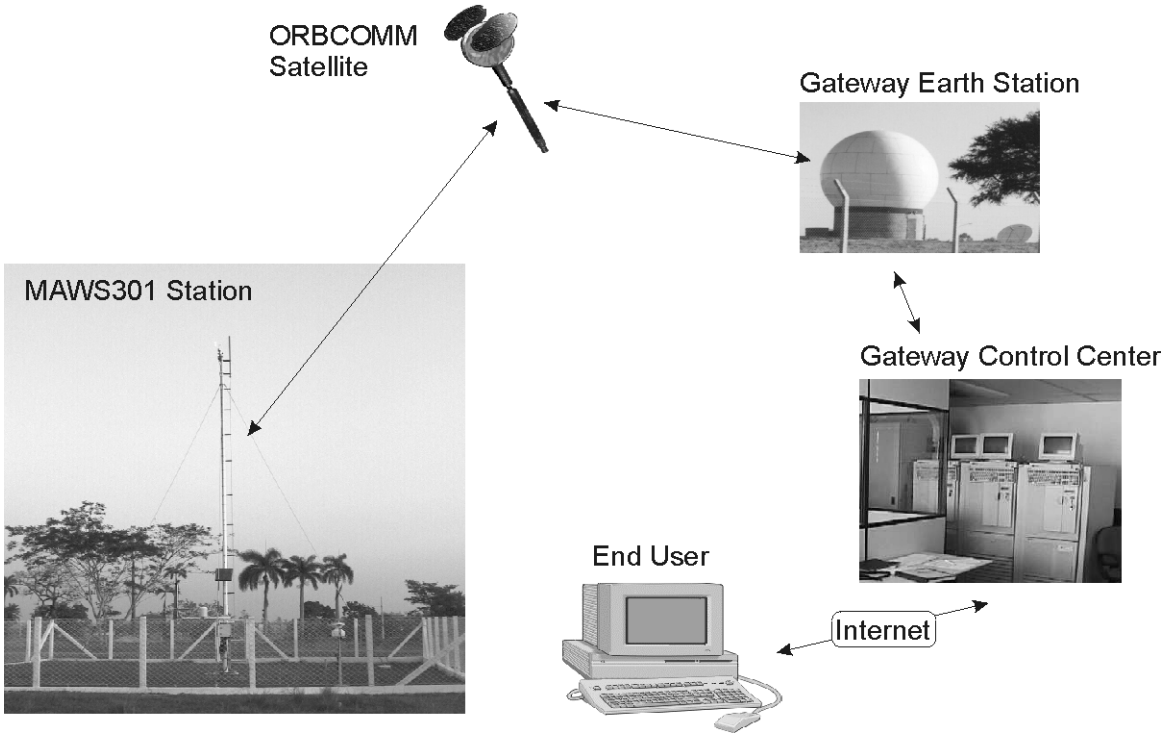


Figure 32 MAWS301 with ORBCOMM

ORBCOMM Data Communication Set QRC101 includes the necessary cables inside the enclosure, coaxial surge arrester for RF-signal, and all mounting hardware. The antenna can be a standard whip antenna shown in Figure 33 on page 43.

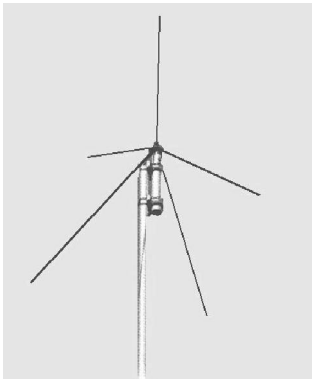


Figure 33 Antenna for the ORBCOMM Satellite Transmitter

GOES Satellite Transmitters

Figure 34 GOES Satellite Transmitter

The Satellite Radio Transmitter makes telemetry possible through the GOES, Meteosat, Argos, and SCD satellites.The transmitter has to be mounted inside the enclosure.The satellite transmitter is provided with the necessary cables, antenna, coaxial surge arrester for RF-signal, and all mounting hardware.

The transmitter has Temperature Compensated Crystal Oscillator (TCXO) which provides the long-term frequency stability necessary to keep the transmitter on the assigned frequency. Use of a GPS receiver, either embedded or external offers additional time management stability. The transmitter is extremely efficient with power and have low power consumption during a transmission, less than 2.75 A.

GOES HDR300 without the internal GPS provides transmission speed of 100 or 300 baud. If you later desire having clock synchronization, the HDR300 easily supports a traditional external GPS or WWV receiver. The channel and data rate are programmable and can be changed as often as each transmission. The transmitter can be set to any of the allowable 199 USA GOES channels (100 and 300 bps) or any 33 International Channels (100 bps).

The GOES HDR1200 transmitter offers the fastest approved baud rate as well as 100 and 300 bps. It also enables the use of an embedded GPS in the design, and the HDR1200 transmitter channels and data rates are programmable on a burst by burst basis. The channel and data rate are programmable and can be changed as often as each transmission. The transmitter can be set to any of the allowable 199 USA GOES channels (100 and 300 bps) or any 33 International Channels (100 bps). For 1200 bps, the transmitter can be set to any of the 1-100 domestic channels.

GOES Crossed Yagi Antenna

GOES Crossed Yagi Antenna is a lightweight, all-weather antenna designed to operate in the 401 to 402 MHz frequency range. This antenna radiates right-hand circular polarized energy in a pencil beam pattern with a beam width of approximately 45 degrees measured at the half-power points. The input impedance is 50 ohms, and the VSWR across the operating frequency range of the antenna is better than 2:1. Antenna gain is approximately 10 dB and is designed to provide optimum signal levels at the GOES satellite when connected to the 10 W GOES radio transmitter. The antenna is designed to be conveniently disassembled for transport.

GPS Antenna

Figure 35 GPS Antenna for the GOES Transmitter

The GPS antenna is delivered with the GOES transmitter for accurate time synchronization. The unit is interfaced via the GOES transmitter with a weather station.

Ultrasonic Wind Sensor

Figure 36 Ultrasonic Wind Sensor WS425

Ultrasonic Wind Sensor WS425 uses ultrasound to determine wind speed and wind direction. The measurement is based on transit time, the time it takes for the ultrasound to travel from one transducer to another, depending on the wind speed. The transit time is measured in both directions for a pair of transducer heads. Using two measurements for each of the three ultrasonic paths at 60° angles to each other, WS425 computes the wind speed and direction. The wind measurements are calculated in a way that completely eliminates the effects of altitude, temperature and humidity.

The sensor has no moving parts and it is resistant to corrosion and contamination since exposed surfaces are stainless steel. In addition to improving accuracy and the reliability of data in all wind conditions and climates, WS425 eliminates on-demand and periodic maintenance.

Optionally, WS425 has a built-in heater. The heated model has thermostatically controlled heaters in the transducer heads to prevent

freezing rain or snow build- up. The standard model operates with a low current from 10 to 15 VDC supply. For the heated model, an additional 36 V supply is used for heating.

From output protocols SDI-12 provides the most extensive set of commands and calculations. The standard RS-232/RS-485/RS-422 protocol supports NMEA and three other message formats. Optionally, WS425 uses the analog signal output providing wind speed and direction data.

An adapter for the Ultrasonic Wind Sensor is included in the mast delivery. It has a clamp for mast attachment and two holes for sensor attachment. See Figure 37 on page 47.

Figure 37 Installation Adapter for Ultrasonic Wind Sensors

Combined Wind Sensor

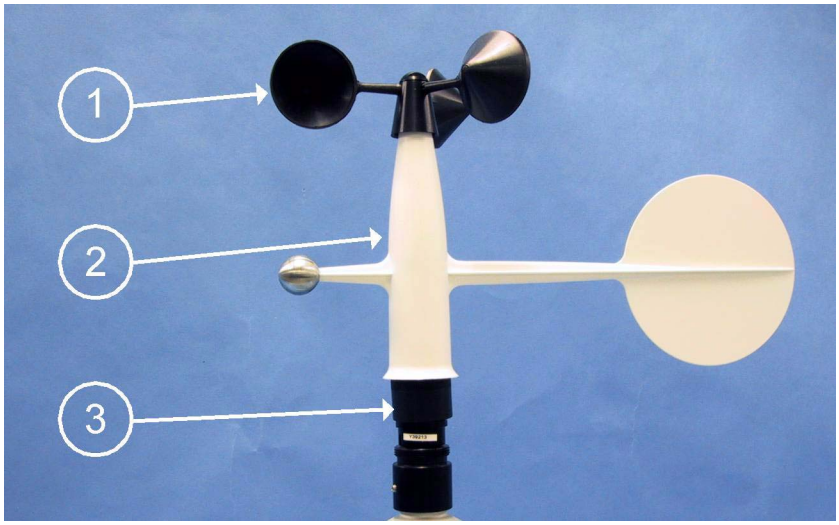


Figure 38 Combined Wind Sensor

The following numbers refer to Figure 38 on page 48:

1 = Cup wheel assembly

2 = Vane assembly

3 = Sensor compartment

Combined Wind Sensor is the compact sized instrument with the wind speed and direction sensors integrated into one unit. A single compact sensor is ideal for low-power applications. The sensor electronics is located inside a watertight compartment providing full protection against water, dust, pollutants, and electromagnetic interference.

The cup wheel shape, dimensions, and material have been carefully designed to achieve maximum measurement quality. The conical cups have been tested to give linear response between wind speed and angular velocity of the cup wheel. The polyamide plastic reinforced with carbon fiber guarantees a rigid structure even at the highest wind speeds.

The balanced wind vane is integrated in the housing, underneath the cup wheel. The circular tail is located far enough from the body and the cup wheel to avoid turbulence due to these structures. The vane assembly is made of PA reinforced with glass fiber providing durable and lightweight structure with fast response and low inertia.

WMS302 has a two-wiper type potentiometer to overcome the wind direction discontinuity. However, a more complex voltage-to-direction conversion process is needed.

Anemometers

Introduction to Anemometer

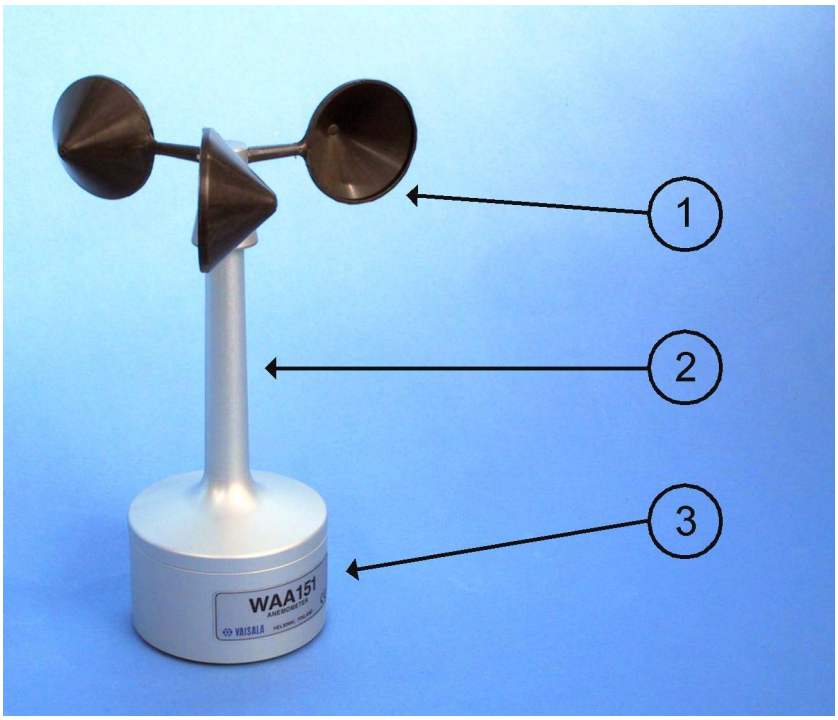


Figure 39 Anemometer WAA151

The following numbers refer to Figure 39 on page 49:

1 = Cup wheel assembly

2 = Sensor shaft

3 = Lower body

WAA151 is an optoelectronic, fast-response, low-threshold anemometer. In the cup wheel it has three light-weight conical cups providing excellent linearity over the entire operating range, up to 75 m/s.

The heating element in the shaft tunnel keeps the temperature of the bearings above the freezing level in cold climates. Nominally it provides 10 W of heating power. It is recommended to use a thermostat switch in the sensor cross arm for switching the heating power on below +4 °C.

Introduction to Heated Anemometer

Figure 40 Anemometer WAA252

Heated Anemometer WAA252 is designed for environments where a non-freezing sensor is required. The foil heaters are inserted into each cup and in the cup wheel hub.

The transmission of heating power to the WAA252's rotor is contactless, with no slip rings or brushes. This feature eliminates sparks and excessive friction or wear. Power to the heaters is supplied via a rotary transformer, with 26 kHz low-EMI sine wave.

Power consumption, typically 72 W, is very low considering the heating efficiency and the protection against freezing provided.

Wind Vanes

Introduction to Wind Vane

WAV151 is a counter-balanced, low-threshold optoelectronic wind vane. Infrared LEDs and phototransistors are mounted on six orbits on each side of a 6-bit GRAY-coded disc. Rotated by the vane, the disc creates changes in the code received by the phototransistors. The code is changed in steps of 5.6°, one bit at a time to eliminate any ambiguities in the coding.

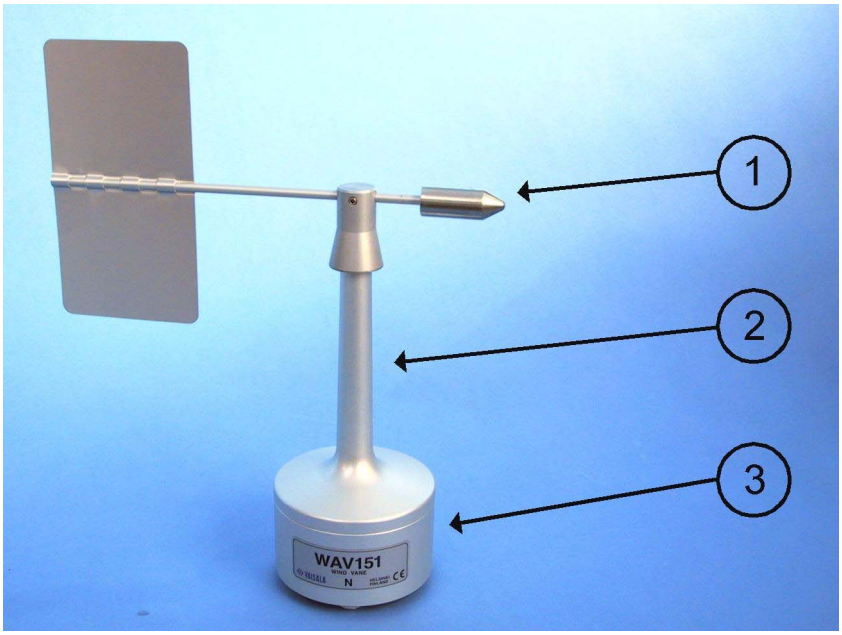


Figure 41 WAV151 Wind Vane

A heating element in the shaft tunnel keeps the temperature of the bearings above the freezing level in cold climates. Nominally, it provides 10 W of heating power. It is recommended to use a thermostat switch in the sensor cross arm for switching the heating power on below +4 °C.

The following numbers refer to Figure 41 on page 51:

1 = Vane assembly

2 = Sensor shaft

3 = Lower body

Introduction to Heated Wind Vane

Heated Wind Vane WAV252 is a non-freezing sensor of novel design. Its lightweight vane offers excellent sensitivity and fast response. The foil heaters integrated in the vane and tail assembly protect the gauge's rotating parts against freezing in all wintry weathers, even in extreme climates.

The transmission of heating power to the WAV252's rotor is contactless, with no slip rings or brushes. This feature eliminates sparks and excessive friction or wear.

Power consumption, typically 50 W, is very low considering the heating efficiency and the protection against freezing provided.

Wind Transmitter

Digital Wind Transmitter

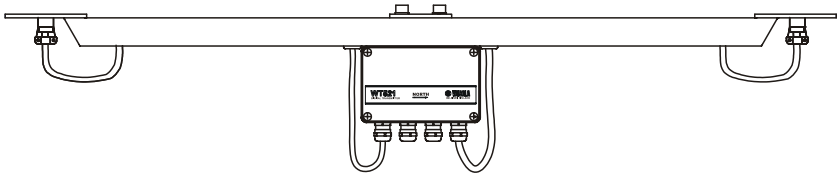


Figure 42 Digital Wind Transmitter WT521

Digital Wind Transmitter WT521 assembly includes a cross arm for easy mounting of Vaisala WAA- and WAV-series wind sensors. A digital transmitter is inside the junction box that is equipped with four glands.

WT521 provides power control for shaft heated sensors. One of the glands is reserved for the heating cable from a local heating/operating power supply.

Air Temperature and Relative Humidity Sensor

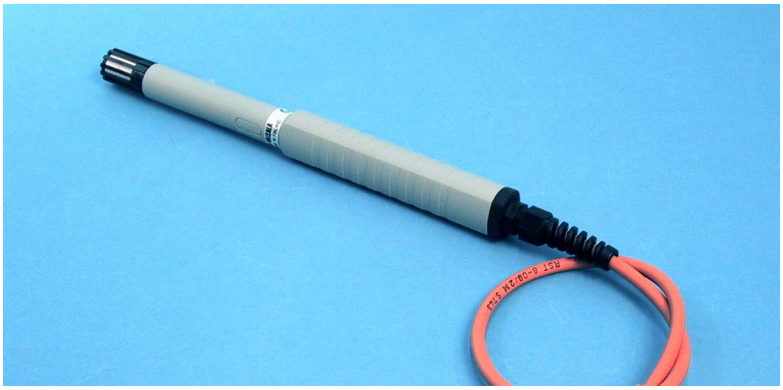


Figure 43 Air Temperature and Relative Humidity Sensor

The Air Temperature and Relative Humidity Sensor is based on Vaisala's field-proven HMP45D probe and comes with a special cable and connector. Humidity measurement is based on the highly accurate capacitive thin film polymer sensor HUMICAP®180 and it offers excellent long-term stability in a wide range of environments. Temperature measurement is based on resistive platinum Pt-100 IEC751, 1/3 Class B sensor. Both the humidity and temperature probes are located at the tip of the sensor and are protected by a membrane filter.

Pressure Sensor

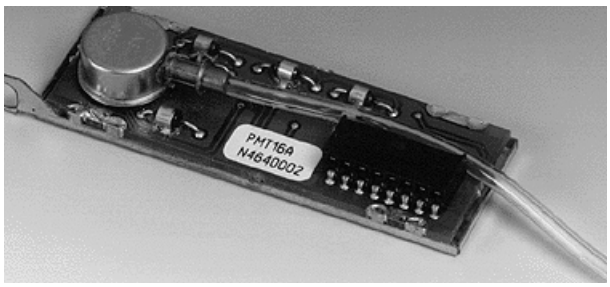


Figure 44 Pressure Sensor PMT16A

The silicon capacitive pressure sensor PMT16A has excellent accuracy, repeatability and long-term stability over a wide range of operating temperatures. Therefore, it maintains its accuracy and calibration for long periods of time, thus reducing the need for field calibrations.

The fine adjustment and calibration of the sensor at the factory are handled according to the electronic working standards, which are based on international standards.

Rain Gauges

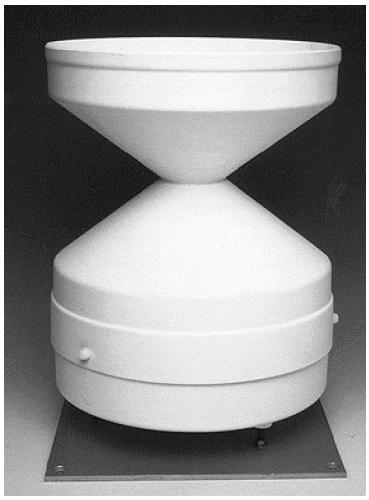


Figure 45 Rain Gauge QMR102

An aerodynamically shaped rain gauge, Precipitation Sensor QMR102 is designed to minimize the wind-originated airflow reducing the catch. Manufactured from UV radiation resistant plastic, that makes it a very rugged instrument.

The collected rain is measured in a well-proven tipping bucket mechanism of 0.2 millimeters. QMR102 is installed on a stand or on a pedestal and it is delivered with a 10-meter shielded cable with a connector.

Figure 46 Rain Gauge RG13

Rain Gauge RG13 has a body and funnel of aluminum alloy, with an accurately machined septum-ring at the top to give an orifice of 400 cm^2. Bucket mechanism is mounted inside the body on a cast aluminum-alloy base incorporating fixing lugs, three leveling screws, and a spirit level.

The rain gauge comprises a divided bucket assembly, which is pivoted at its center like a seesaw. Rain collects in the upper half of the bucket, which is adjusted to tilt when a predetermined amount of water has been collected. The tilting action discharges the collected water, and repositions the opposite half under the discharge nozzle ready for filling. The bucket tips are monitored by means of a magnet, which energizes a reed switch capable of a virtually indefinite amount of operations. This system ensures that the tipping bucket has a long, reliable working life.

Figure 47 Heated Rain Gauge RG13H

The RG13H heated tipping bucket type rain gauge provides a well-proven and reliable method of monitoring rainfall also at temperatures below 0 °C. RG13H is equipped with the internal heater. The heater switches on at temperatures below +4 °C. The heater power consumption is 38 W/40 VDC.

Rain Detector

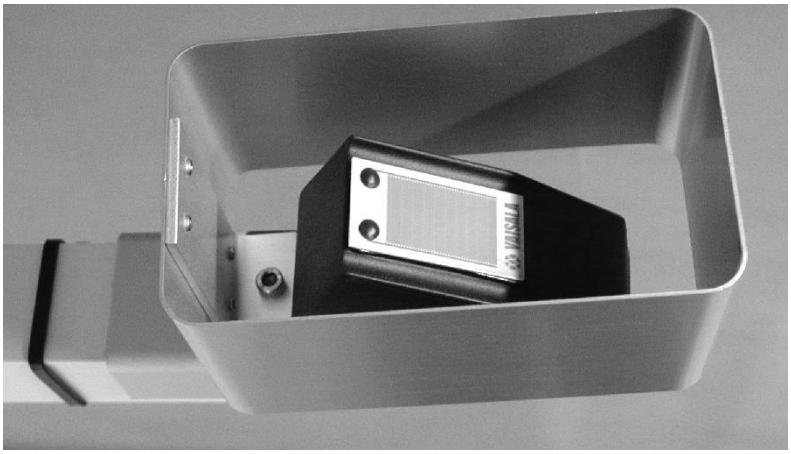


Figure 48 Rain Detector DRD11A

Rain and snow are detected quickly and accurately with Rain Detector DRD11A. It operates via droplet detection.A special delay circuitry allows about two-minute interval between raindrops before assuming an OFF (no rain) position. This enables the sensor to accurately distinguish between rain cessation and light rain.

DRD11A is positioned at a 30° angle. This design, together with the internal heating element, ensures that the surface dries quickly, an essential factor in calculating intensity. The same heating element also protects the surface from fog and condensed moisture. In addition, the heating element is activated at low temperatures in order to melt snow, thus allowing snow detection. Sensor performance is not affected by reasonable amounts of dirt and dust due to droplet detection.

Due to the heating power requirements, DRD11A is recommended to be used only at stations equipped with AC power.

The DRD11A sensor set includes the sensor itself, cable, connector, small signal conditioner card, and installation accessories for the sensor arm.

Ultrasonic Snow Level Sensor

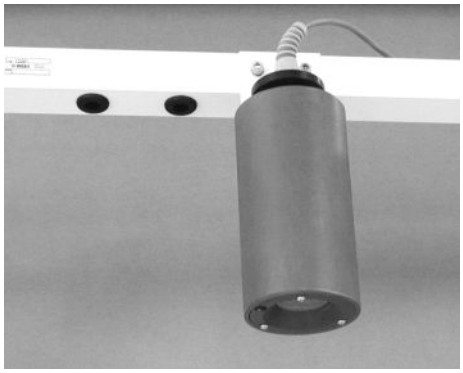


Figure 49 Ultrasonic Snow Level Sensor DCU7210

For measurement of snow levels, the DCU7210 Ultrasonic Snow Level Sensor features an electrostatic transducer in a protective case. The sensor is PVC encased and weather resistant.

Traditionally, snow level measurement is achieved through physical measurements which are labor intensive and provide limited data. The DCU7210 sensor simplifies and improves this process by providing remote measurement of snow levels.

DCU7210 is a self-contained sensor with internal temperature compensation and highly sensitive ceramic transducer. The sensor is configured via RS-232 port using an easy to use software. After this, the sensor is connected to one of the analog inputs of the logger.

Solar Radiation Sensors

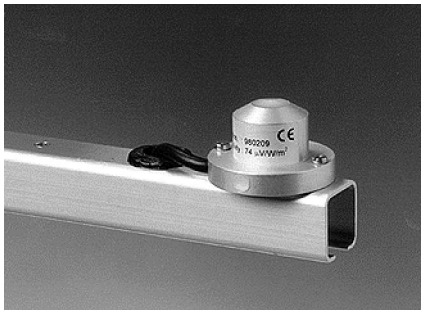


Figure 50 QMS101 Pyranometer

The QMS101 pyranometer is used for measuring global solar radiation. QMS101 uses a photodiode detector for creating a voltage output proportional to the incoming radiation. Due to the unique design of the diffuser, its sensitivity is proportional to the cosine of the angle of incidence of the radiation, thus allowing accurate and consistent measurements. QMS101 has a ready-made cable with a connector, and it is easily installed on the sensor support arm.

Figure 51 QMS102 Pyranometer

QMS102 Pyranometer is an ISO/WMO-classified second class pyranometer. The precision optical glass dome acts as a filter, with a spectral band-pass that permits the full solar spectrum to pass through to the sensor. The sensor is a high-quality blackened thermopile with a flat spectral response. Heating of the sensor by incoming solar radiation produces a signal in the microvolt range.

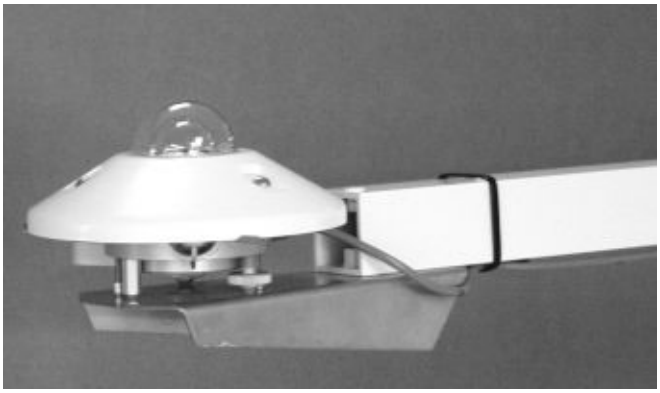


Figure 52 Pyranometer CM6B

CM6B Pyranometer is an ISO 9060 first class pyranometer. CM6B incorporates a 64-thermocouple sensor, which is rotationally

symmetrical and housed under K5 glass domes. A white screen prevents the body of the pyranometer from heating up.

Figure 53 Albedometer CM7B

The CM7B albedometer is suitable for measuring net global radiation and/or albedo over many differing types of surface. The sensor has conical lower screen, to prevent illumination of the lower glass dome at sunrise and sunset. The CM7B albedometer is constructed around two CM6B 64-thermocouple sensors, which are rotationally symmetrical and housed under K5 glass domes.

A white screen prevents the body from heating up. The albedometer is equipped with a spirit level and screws for accurate levelling. A drying cartridge keeps the interior free from humidity. The albedometer is supplied with a calibrationcertificate.There are two operating modes for an albedometer: net global radiation is measured with the sensors connected in anti-series. Separate recordings of the outputs and a subsequent measurement of the ratio of one output to the other yields the albedo calculation.

Figure 54 Pyranometer CM11

CM11 Pyranometer is an ISO 9060 secondary standard pyranometer. CM11 incorporates a 100-thermocouple sensor, which is rotationally symmetrical and housed under K5 glass domes. A white screen prevents the body of the pyranometer from heating up.

Net Radiometer

Figure 55 Net Radiometer CNR1

The Net Radiometer, CNR 1, is intended for the analysis of the radiation balance of the Solar and Far Infrared radiation. The most common

application is the measurement of Net (total) Radiation at the earth's surface.

The CNR1 sensor consists of two pyranometers, model type CM3, for measuring solar radiation, and of two pyrgeometers, model type CG3, for measuring Far Infrared radiation.The properties of CNR1 are mainly determined by the properties of the individual sensors, both the CM3's and CG3's. The combination of these sensors offers the advantage of accuracy, robustness, and the possibility to evaluate the quality of the measured data.

From a spectral point of view, the CM3 and CG3 are complementary. Together they cover the full spectral range: The CM3 from 0.3 to 3 microns, and the CG3 from 5 to 50 microns. The gap between these two produces negligible errors.

CNR1 has several output signals: two voltages for the model type CM 3 pyranometers, two voltages for the model type CG 3 pyrgeometers, and a 4 wire Pt-100 connection. A heater is incorporated. The heater is intended to prevent dew and frost deposition at night. Heating generally improves accuracy but at the same time introduces some measurement errors. It is not a necessity.The maximum allowable power for the heater is 50 VA. In case of snow or frost one might also consider heating at a higher level than the usual 6 VA. Heating at 20 VA will melt snow in most cases. 20 VA can be reached at 22 Volts. During high power heating, measurement accuracy cannot be specified. You are advised to reject measured data readings during this high power heating. If lower voltage is available, one might consider heating at a lower power. The 6 VA is designed for extreme conditions, 2 VA is sufficient for moderate conditions. Time needed for reaching a stable instrument temperature when heating is about 60 minutes.

Generally the accuracy of CNR1 will be higher than that of competitive Net-Radiometers. The main reason for this is that the solar radiation measurement performed by the CM3 is accurate, and offers a traceable calibration. Due to the fact that the Net Solar radiation can be very intense, 1000 Watts per square metre compared to a typical -100 for the Net Far Infrared radiation, the accuracy of the solar measurement is very critical. The CM3 is an instrument that complies with the ISO second class specifications, and can be relied upon to give an accurate reading. Wind corrections, as applied by less accurate competitive instruments are not necessary. The robustness of the materials used implies that CNR 1 will not suffer from damage inflicted by birds.

The CNR1 sensor is delivered with an additional junction box to enable the wiring to the Vaisala data loggers. The junction box includes factory made cables.

Figure 56 Junction Box for the CNR1 Sensor

Net Solar Radiation Sensor

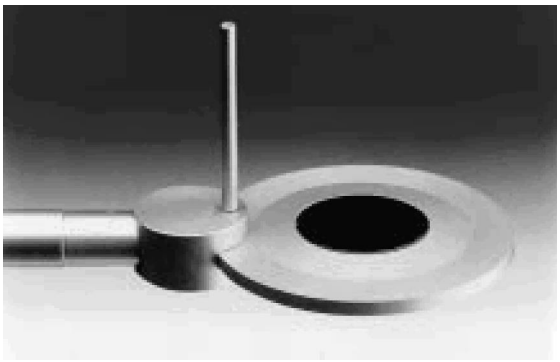


Figure 57 Net Solar Radiation Sensor QMN101

Net Solar Radiation Sensor QMN101 is designed for routine measurements of net radiation. Net radiation is the balance between incoming and outgoing radiation in outdoor conditions. The sensor measures solar and far infra-red radiation balance.

The sensor is based on a thermopile and it consists of two Teflon-coated, weather-resistant black conical absorbers. The voltage output is proportional to the net radiation. Contrary to common instruments, QMN101 is virtually maintenance-free as it does not require fragile plastic domes.

Soil/Water Temperature Sensor

Figure 58 Soil/Water Temperature Sensor

Soil/Water Temperature Sensor is particularly intended for precision measurement of ground and soil temperatures. All the materials have been carefully selected to withstand various environmental stress and wide temperature range. The measurement accuracy and stability of the temperature sensor are based on a Pt-100 type sensor element specified to 1/4 DIN 43760B preciseness level.

The QMT103 sensor includes a 5-meter cable with a black, weather-resistant polyurethane (PUR) sheath, which can tolerate both abrasive wear and extreme temperatures. Molded to the other end of the cable there is a 5-pin watertight connector, providing for instant assembly and replacement.

The QMT110 sensor includes a 10-meter cable with a black, weather-resistant polyurethane (PUR) sheath, which can tolerate both abrasive wear and extreme temperatures. Molded to the other end of the cable there is a 5-pin watertight connector, providing for instant assembly and replacement.

Soil Temperature Sensor

Figure 59 Soil Temperature Sensor QMT107

Soil Temperature Sensor QMT107 is designed for the measurement of soil temperature and temperature profiles as a function of depth. Temperature measurement is based on resistive platinum sensors (Pt-100). There are seven temperature probes located inside the sensor. The sensors are positioned to +5 cm, ±0 cm, -5 cm, -10 cm, -20 cm, -50 cm, and -100 cm levels, where ±0 cm corresponds to the ground level mark of the sensor.

The sensor is constructed of glass fiber tube filled with epoxy, which makes the design watertight and provides low thermal conductivity. This ensures maximum accuracy as the sensor itself consumes very little power, thus causing almost no self-heating. The sensor has a 1-meter cable, which can be extended with the extension cables of different lengths.

Soil Moisture Sensor

Figure 60 Soil Moisture Sensor ML2x

Soil Moisture Sensor ML2x features a new technique with the accuracy of ±2 % soil moisture. The ML2x sensors offer high accuracy and extended lifetime in permanent or temporary measurements of soil moisture.

Traditional low cost sensors made of gypsum block dissolve even in a short period of time when exposed to high moisture. The ML2x sensors are very durable. The rods are 60 mm long, made of resilient, solid stainless steel, and can be unscrewed and replaced if necessary. All exposed materials are either stainless steel or durable plastic, and the probes are fully sealed. This way they can also safely be buried into the ground.

Soil Moisture Sensor

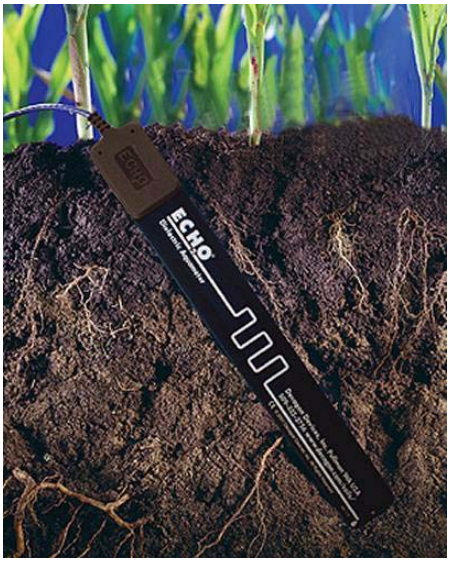


Figure 61 Soil Moisture Sensor ECH2O-M3

The ECH2O-M3 probe is a low-cost sensor for measuring volumetric water content of soil and other porous materials. It uses capacitance to measure the dielectric permittivity of the surrounding medium. The volume of water in the total volume of soil most heavily influences the dielectric permittivity of the soil because the dielectric of water (80) is much greater than the other constituents of the soil (mineral soil, 4; organic matter, 4; air, 1). Thus, when the amount of water changes in the soil, the ECH2O-M3 probe will measure a change in capacitance (from the change in dielectric permittivity) that can be directly correlated with a change in water content. Circuitry inside the ECH2O-M3 probe changes the capacitance measurement into a proportional millivolt output. The ECH20-M3 probe has a low sensitivity to salt and temperature, and very low power consumption.

Leaf Wetness Sensor

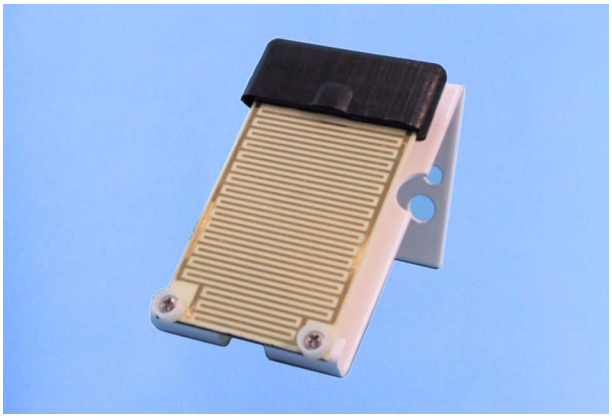


Figure 62 Leaf Wetness Sensor QLW101

Leaf Wetness Sensor QLW101 enables data logger to detect the presence of surface moisture on foliage and calculate the duration of wetness. When moisture is present, the sensor detects an electrical resistance change between the gold-plated elements of the grid.

Fuel Moisture/Fuel Temperature Sensor

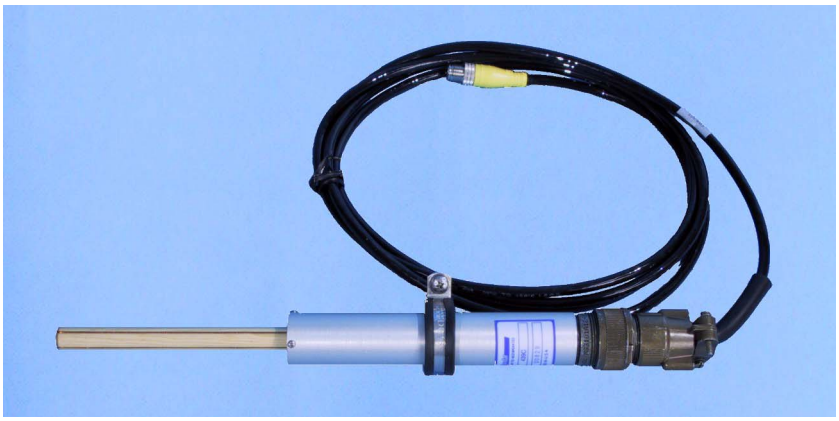


Figure 63 Fuel Moisture/Fuel Temperature Sensor

Fuel Moisture/Fuel Temperature Sensor measures the moisture content of the material on the forest floor or other natural area to help forest managers assess the fire danger. It uses a carefully selected and prepared pine dowel to exchange moisture with the environment. The

sensor measures the moisture content of the dowel by its electrical capacitance.

A thermistor, located in the dowel where it fastens to the base, measures the temperature of the dowel giving the estimated temperature on the forest floor.

Visibility Sensors

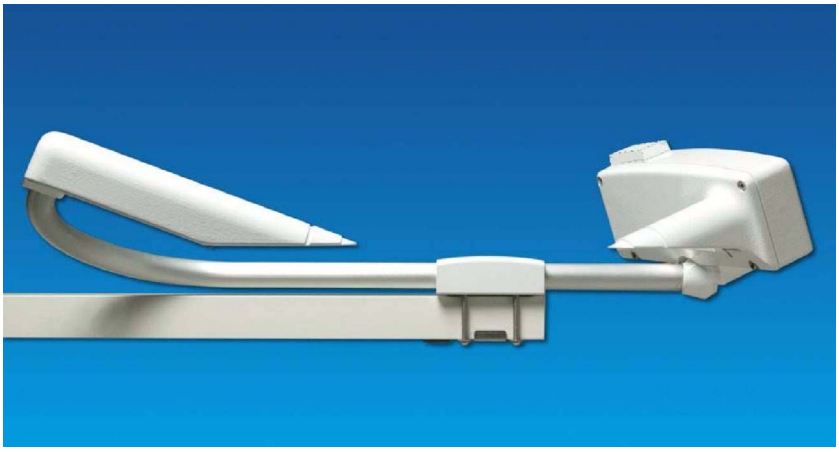


Figure 64 Visibility Sensor PWD10/PWD20

Vaisala Visibility Sensor PWD10 and PWD20 are optical sensors that measure visibility (meteorological optical range, MOR). The sensor measures visibility using the principle of a forward scatter measurement.

With a measurement range of from 10 to 2000 meters, the Vaisala Visibility Sensor PWD10 offers economical and reliable visibility measurement for weather applications.

The PWD10/20 output is either a digital serial interface or an analog current signal. The digital serial interface can be configured into two different operating modes: the sensor can be set to send a data message automatically at selected intervals, or PWD10/20 can be polled by the host computer. The same serial line is also used as an operator interface. The analog current signal can be used to report the prevailing visibility. Three relay controls can be used, driven by visibility limits.

The operator controls and checks the operation of PWD10/20 using a maintenance terminal. A set of built-in commands and test routines are

provided for configuring and monitoring the multiple functions of PWD10/20.

The standard data messages contain a status character for indicating faults detected by the internal diagnostics. If the error status is set, the operator can display a special status message, which contains the detailed results of the diagnostics and a written description of the fault. With this information the operator can take corrective action or give the maintenance personnel advice.

Present Weather Detectors

Figure 65 Present Weather Detector PWD22

The Vaisala Present Weather Detectors PWD12 and PWD22 identify precipitation type by accurately estimating the water content of precipitation with a capacitive device (Vaisala RAINCAP® sensor element) and combining this information with optical forward scatter and temperature measurements. These three independent measurements are processed through sophisticated algorithms in order to produce an

accurate evaluation of the weather type according to the WMO and NWS code tables.

PWD12 is an intelligent, multi-variable sensor for automatic weather observing systems. The sensor combines the functions of a forward scatter visibility meter and a present weather sensor. PWD12 can measure the intensity and amount of both liquid and solid precipitation. If the detector is equipped with an optional background luminance sensor, it can also measure ambient light.

PWD22 is equipped with two Vaisala RAINCAP® sensor elements to improve detection sensitivity during light precipitation events – even light drizzle is detected. With a visibility measurement range of 10–20,000 meters, the Vaisala Present Weather Detector PWD22 is a two-in-one forward scatter visibility and present weather sensor. PWD22 is recommended for automatic weather stations (especially low-power AWSs) that are used for general meteorological and aviation applications. The PWD22's ability to detect freezing precipitation makes it possible to issue warnings when the weather presents safety hazards.

Ceilometer

Figure 66 Ceilometer CT25K

The CT25K laser ceilometer is a new generation general purpose cloud height sensor. CT25 employs pulsed diode laser LIDAR (Light Detection and Ranging) technology for detection of clouds, precipitation and other obstructions to vision, and accurate determination of cloud heights and vertical visibility.

The standard measurement range of CT25K extends up to 25 000 feet (7.5 km) covering most heights where dense cloud appears. The instrument is capable of reporting up to three cloud layers simultaneously. It detects the cloud base reliably in fog, rain, snow, and haze. If the cloud base is obscured, CT25K measures and reports the vertical visibility.

Extensive internal monitoring is supported by a comprehensive set of user commands that can be given locally or remotely. The internal monitoring includes a sensor measuring the outgoing laser pulse energy, a circuitry checking the receiver sensitivity, a sensor monitoring window contamination and a sensor measuring the tilt angle. These and other internal measurements are used by the diagnostics software and the detection algorithm for maximum reliability and ease of use.

Visibility Sensor

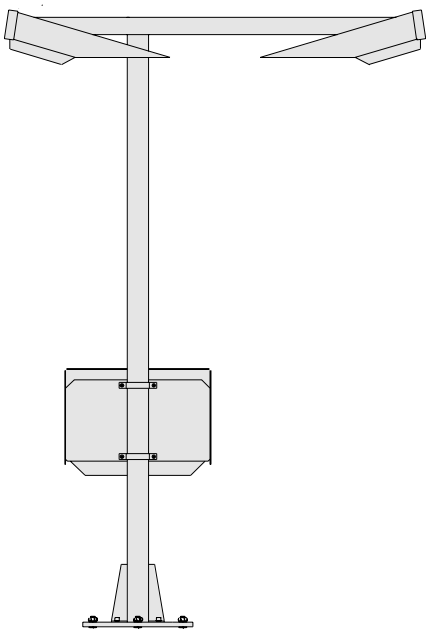


Figure 67 Visibility Sensor FD12

The FD12 forward-scatter visibility sensor evaluates the Meteorological Optical Range (MOR) by measuring the scatter of infrared light in the air. Typical applications of FD12 are visibility measurement at airports and onboard ships, fog detection and warning for highways, and meteorological observations at remote locations.

FD12 consists of a transmitter, a receiver, and a controller. The simplified mechanical design means minimum disturbance to the sample volume of air. The compact construction and factory set mountings ensure easy installation and eliminate problems with startup adjustments.

Present Weather Sensor

Figure 68 Present Weather Sensor FD12P

Present Weather Sensor FD12P is an intelligent multi-variable sensor that combines the functions of a forward scatter visibility sensor and a present weather sensor. In addition, FD12P can measure the intensity and amount of both liquid and solid precipitation.

The versatility of FD12P is achieved with a unique operating principle. FD12P measures precipitation water content with a capacitive device and combines this information with optical scatter and temperature measurements. These three independent measurements together provide sufficiently data for an accurate evaluation of prevailing visibility and weather type.

CHAPTER 3
OPERATION

This chapter provides the instructions for taking MAWS into use when all the equipment has been assembled and installed, as well as operating instructions for the MAWS Terminal software.

Operation Principle

MAWS works based on a so-called setup. Setup is a set of parameters that tells MAWS what to measure, log, calculate, and report. Measured data is stored in the daily log files that can be downloaded to a PC and viewed using the MAWS Terminal software. Alternatively, the data values can be viewed with the YourVIEW software, the optional handheld terminal, or Vaisala Digital Displays. The delivery/project specific data reports can be configured to collect data from MAWS stations by data collection systems.

The Basic setup has been loaded in the MAWS program memory already at the factory. This allows you to just connect the sensors, connect communication lines, and supply power to MAWS. Then your station will start operating: making measurements, doing calculations and sending report(s). Normally, these example setups need to be modified according to delivery specific requirements.

On the MAWS CD-ROM, delivered to you with the system, you will find several setup examples. The delivered setups will suit typical needs, but you may want to make changes to them. For reconfiguring the setup files or making totally new ones, refer to the MAWS Lizard Setup Software User's Guide.

Taking MAWS into Use

Aligning Wind Vane

Using winddircal0 Command

1. Turn the nose (number 1 in Figure 69 on page 76) of the vane to a known point of compass, for example, north.
2. Open MAWS Terminal.
3. Give command **open** to open the connection to MAWS. The **open** command is not echoed on the screen.
4. Give command **winddircal0** with the direction reading, for example, **winddircal0** *360*. This will set the current direction to the north, which equals 360 degrees.

Using Compass and Reference Point

With MAWS running, monitor the instant wind direction in the reports sent through serial line.

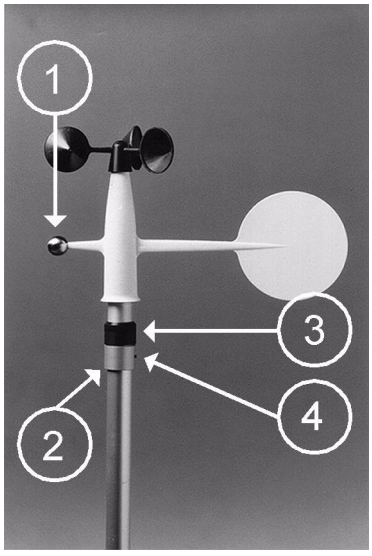


Figure 69 Aligning Wind Vane

1. The wind sensor cable must be connected both to the sensor and to the **Wind** connector.

2. The mounting piece (2) must be placed on top of the tube and the sensor must be attached to the mounting piece with the plastic collar (3).
3. Choose a known wind direction reference point on the horizon with the help of a compass.
4. Point the nose of the vane at the reference point.
5. Hold the vane in position and slowly rotate the mounting piece until wind direction shows proper value.
6. Secure the mounting piece to the mast by tightening the mounting screw (4).

Setting Up Solar Panel

NOTE	The rays of the sun should be perpendicular to the panel, which means sunlight should hit the panel at a 90° angle.

1. Face the panel south (true south, not magnetic) on the Northern Hemisphere and north on the Southern Hemisphere. The panel can be tilted towards the sun the further you are from the equator the more vertical the panel.
2. To maximize the annual energy output, install the panel at an angle recommended in Table 6 on page 78. At some installations, it may be effective to adjust the tilt seasonally. At most latitudes, performance can be improved during summer by using an angle smaller than the table's recommendation. Conversely, a larger angle can improve winter performance.

   To set the correct tilting angle, slightly loosen the fixing bolts (1) and the adjustment bolts (2). Tilt the panel to the suitable angle, see Table 6 on page 78. Finally, tighten the bolts. Note the cable (3) when adjusting the angle.

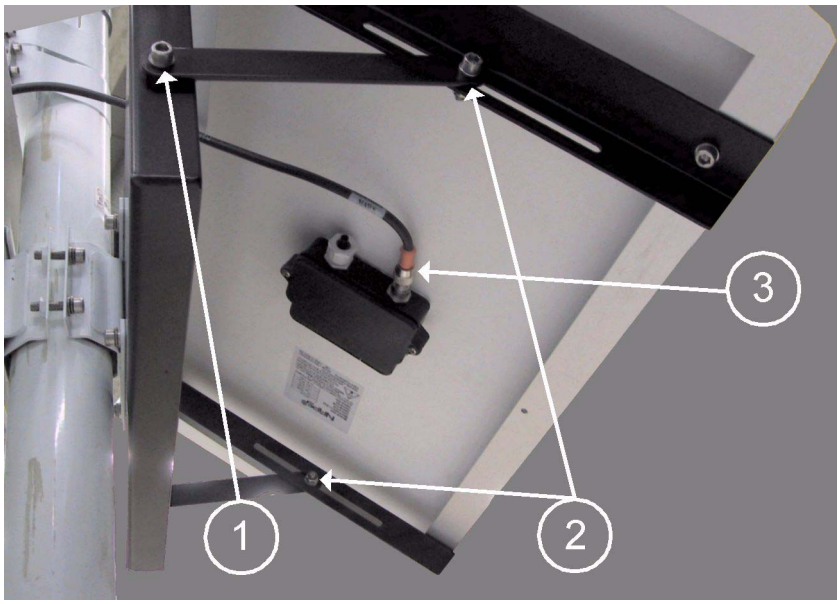


Figure 70 Solar Panel Angle Adjustment

Table 6 Recommended Tilt Angle for Solar Panel

Latitude of Site	Tilt Angle
0 ...10°	20°
10 ... 50°	Add 10° to local latitude
> 50°	60°

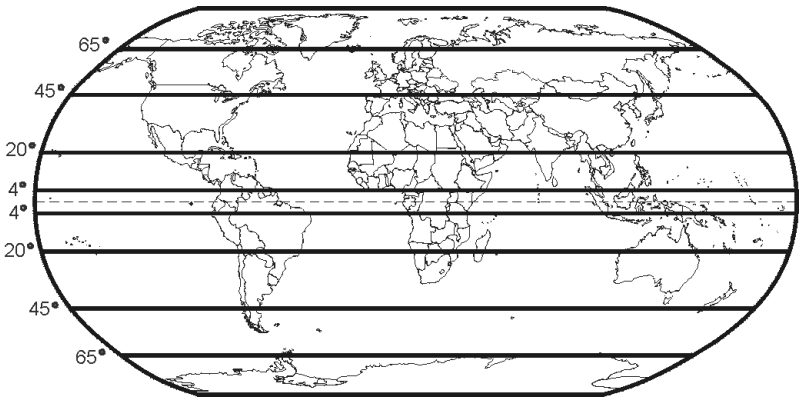


Figure 71 Map of Latitudes

Quick Start Instructions

The quick start instructions in Table 7 on page 79 are based on the following assumptions:

- You will use a default setup already loaded in MAWS.
- You have already assembled the MAWS system.

Table 7 Quick Start Instructions

Step	Action	Detailed Instruction
1.	Connect power to MAWS.	You can use the AC (mains) power supply or the solar panel.
2.	Establish terminal connection with MAWS.	See section Establishing Terminal Connection on page 79.
3.	Start the MAWS Terminal software.	See section Using MAWS Terminal Software on page 81.
4.	Set up station-dependent settings for MAWS.	See section Modifying Station Settings on page 92.
5.	Test the setup.	With the chosen setup loaded into MAWS (see section MAWS Configuration File on page 102), check that you start receiving reports and that logging begins.

When taking MAWS into use for the first time or after connecting the battery, make sure that the station dependent settings are correct, see section Using MAWS Terminal Software on page 81. For more information about the commands, see Table 18 on page 123.

NOTE Make sure that the battery is fully charged, if not, charge the battery before taking MAWS into use.

Establishing Terminal Connection

To connect your computer to a MAWS serial port, proceed as follows:

1. Connect the provided terminal cable (QMZ101) to the **Maintenance terminal** connector on the bottom flange of the enclosure and to an available COM port on your PC. See Figure 72 on page 80.

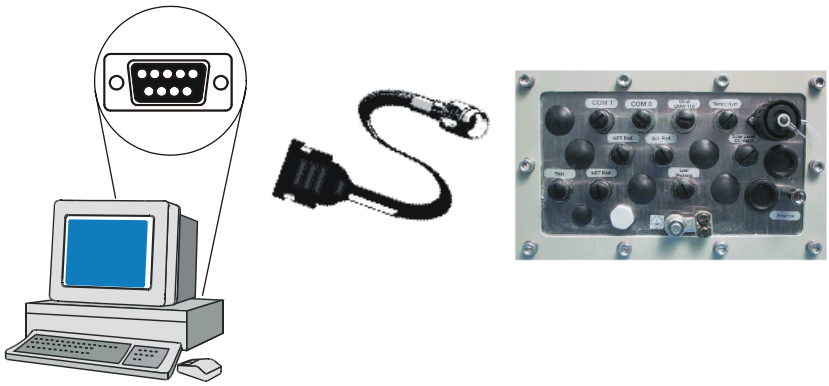


Figure 72 Connecting the Terminal Cable

2. Start the MAWS Terminal program on your PC, as instructed in section Using MAWS Terminal Software on page 81.
3. Set communication parameters: 9600, N, 8, 1.For more information, see section Opening MAWS Service Connection on page 87.
4. Give the command **open** (if the connection is not already open). For more information, see section Giving Commands on page 89.

NOTE	The command **open** is not echoed on the screen.

Figure 73 on page 80 shows the pin order for the terminal connector.

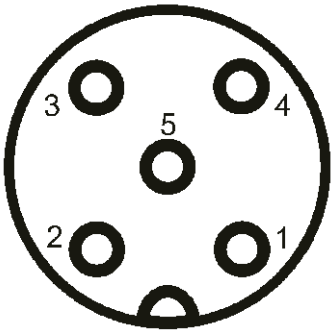


Figure 73 COM0 Pins for the Terminal Connector

The following numbers refer to Figure 73 on page 80.

1 = Not connected

2 = RxD

3 = GND

4 = TxD

5 = Not connected

Using MAWS Terminal Software

Selecting the Language

When you start MAWS Terminal for the first time, you will be asked to select the language you would like to use. The **Select Language** window, presented in Figure 74 on page 81, will appear. Select the desired language and click **OK**.

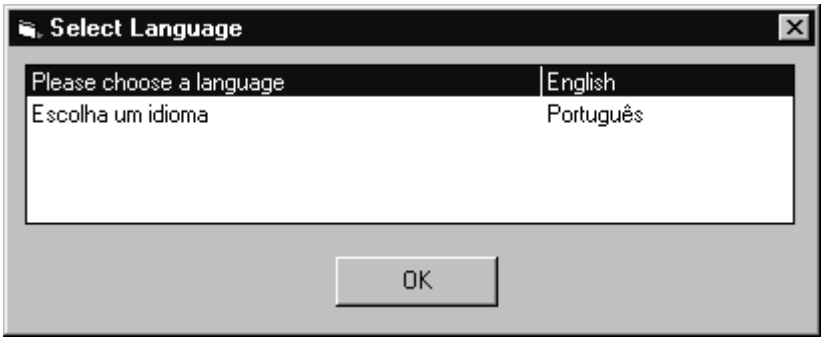


Figure 74 Select Language Window

The **Select Language** window will only appear when MAWS Terminal is started for the first time. To change the language later, choose **Preferences** from the **Settings** menu, and then select the **Language** tab. In the **Language** tab, select the desired language from the **Available Languages** box and click **OK**.

MAWS Terminal Main Window

After selecting the language, or when you later start the MAWS Terminal software by clicking the **MAWS Terminal** icon on your desktop, the following window appears.

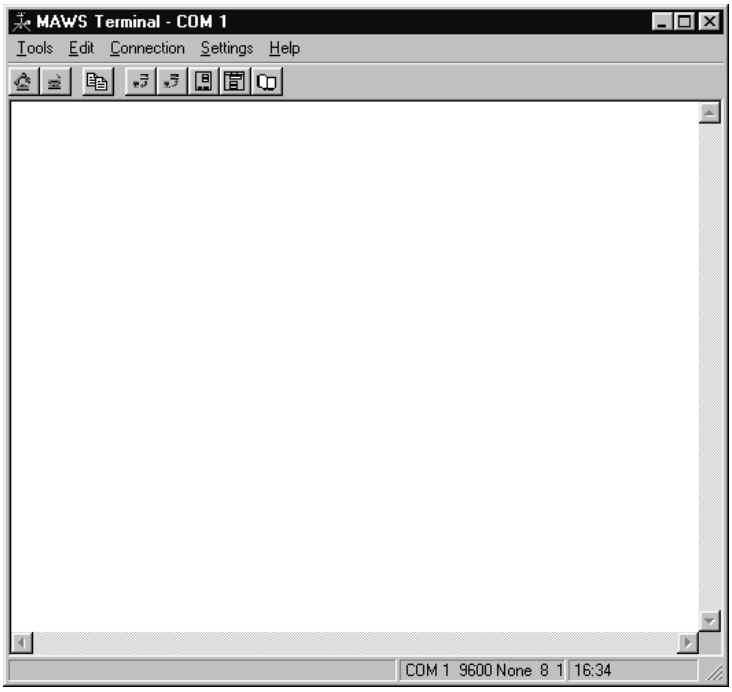


Figure 75 MAWS Terminal Main Window

When the service connection is closed, the messages and reports appear on the main window as shown in Figure 76 on page 83. Some values are shown as slashes, because they will later be calculated from the measured values.

NOTE	Report type and appearance shown in Figure 76 on page 83 depend on your configuration.

When you have typed **open**, the service connection is open and you can communicate with MAWS with the commands described in Table 18 on page 123.

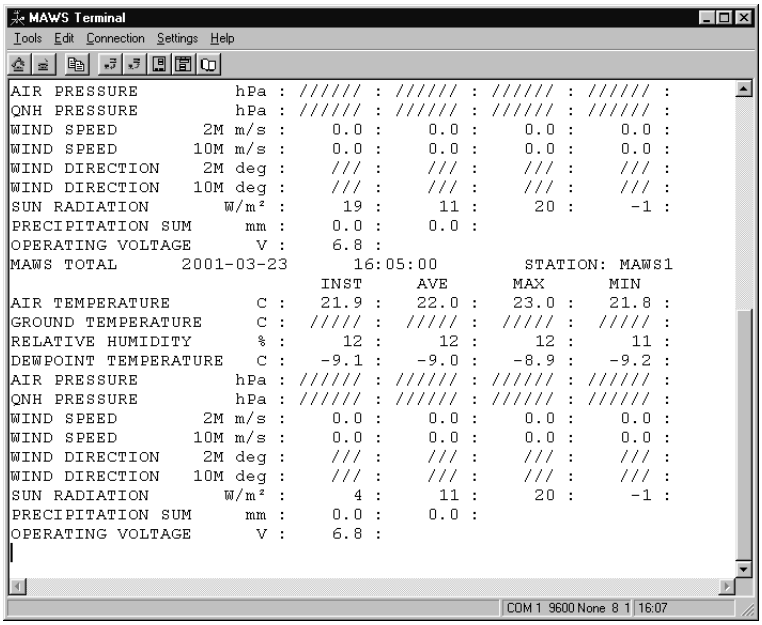

MAWS Terminal
Tools Edit Connection Settings Help
AIR PRESSURE hPa : ////// : ////// : ////// : ////// :
QNH PRESSURE hPa : ////// : ////// : ////// : ////// :
WIND SPEED 2M m/s : 0.0 : 0.0 : 0.0 : 0.0 :
WIND SPEED 10M m/s : 0.0 : 0.0 : 0.0 : 0.0 :
WIND DIRECTION 2M deg : /// : /// : /// : /// :
WIND DIRECTION 10M deg : /// : /// : /// : /// :
SUN RADIATION W/m² : 19 : 11 : 20 : -1 :
PRECIPITATION SUM mm : 0.0 : 0.0 :
OPERATING VOLTAGE V : 6.8 :
MAWS TOTAL 2001-03-23 16:05:00 STATION: MAWS1
INST AVE MAX MIN
AIR TEMPERATURE C : 21.9 : 22.0 : 23.0 : 21.8 :
GROUND TEMPERATURE C : ///// : ///// : ///// : ///// :
RELATIVE HUMIDITY % : 12 : 12 : 12 : 11 :
DEWPOINT TEMPERATURE C : -9.1 : -9.0 : -8.9 : -9.2 :
AIR PRESSURE hPa : ////// : ////// : ////// : ////// :
QNH PRESSURE hPa : ////// : ////// : ////// : ////// :
WIND SPEED 2M m/s : 0.0 : 0.0 : 0.0 : 0.0 :
WIND SPEED 10M m/s : 0.0 : 0.0 : 0.0 : 0.0 :
WIND DIRECTION 2M deg : /// : /// : /// : /// :
WIND DIRECTION 10M deg : /// : /// : /// : /// :
SUN RADIATION W/m² : 4 : 11 : 20 : -1 :
PRECIPITATION SUM mm : 0.0 : 0.0 :
OPERATING VOLTAGE V : 6.8 :
COM 1 9600 None 8 1 16:07

Figure 76 MAWS Terminal Showing Report

On the top of the main window, there is the MAWS Terminal toolbar. The toolbar is the quickest way to select functions.

Table 8 Description of the Toolbar

Icon	Function	Description
	Dial	Establish a connection to the MAWS station you have selected or to the modem you use for connecting to MAWS.
	Hangup	Close the connection to MAWS.
	Copy	Copy the selected text to Windows Clipboard.
	Download Log Files	Select the data log files you want to download and start downloading.
	Upload Configuration File	Select the new configuration file you want to upload and start the uploading.
	Set Station Settings	Define default settings for the MAWS station.
	Preferences	Define default settings for the download.
	Address Book	Open the address book for browsing communication settings.

You can exit MAWS Terminal by choosing the **Exit** option from the **Tools** menu.

Defining MAWS Terminal Settings

When you start the software for the first time, you need to define the settings you want to use during download. You can do this with **Settings** menu options.

Preferences Window

When you choose the **Preferences** option from the **Settings** menu, the **Preferences** window appears with the **Directories** tab.

Table 9 Description of Preference Window Tabs

Tab	Description
Directories	On the **Directories** tab, you can define the directories you want to use for downloading and storing files, see Figure 77 on page 85. If you do not define a directory, the program stores all file types in C:\MAWS_LOG.
Download	On the **Download** tab, you can define the operations that the program runs automatically whenever you download data log files from MAWS, see Figure 78 on page 86.
Communications	On the **Communications** tab, you can define the communication port and related parameters. The default values are COM1, 9600, None, 8, None, 1, and buffer size 4 kB. Normally, you do not need to change the communication settings.
Dialer	If your system connects to MAWS via a modem, you can select how many times the modem tries to connect to MAWS if the first attempt is unsuccessful.
CSV formatting	On the **CSV formatting** tab, you can define whether the date and time information is stored in separate columns or as one character string, e.g., `Wed Jan 02 02:03:55 1980.`
MAWS Station settings	When you update the MAWS configuration file and the system is reset, MAWS spends a defined period checking the configuration. During this time, it does not respond to commands you send to the maintenance line. On this tab, you can define the length of the delay period.

Table 9 Description of Preference Window Tabs

Tab	Description
Show Dialogs	On the **Show Dialogs** tab, you can select which dialogs you want displayed during the download process.
Language	On the **Language** tab, you can select the language that is used in the interface.

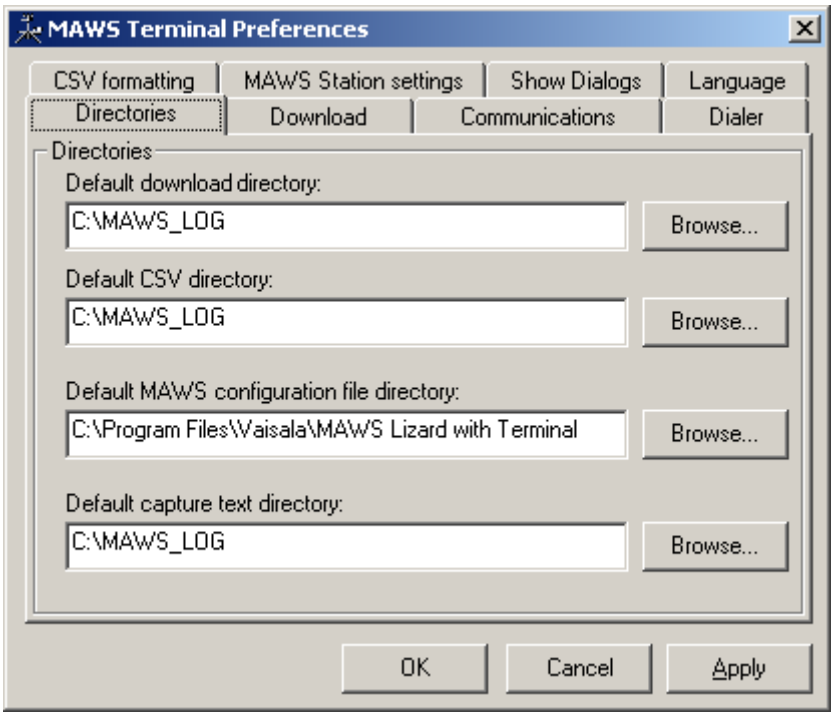


Figure 77 Directories Tab in Preferences Window

When you select **Convert file to CSV format** on the **Download** tab, you may also enable merging of the downloaded files by selecting **Merge CSV files of same log group**.

The merge feature can also be selected case by case in either of the two windows:

1. When downloading the files from MAWS with the MAWS Terminal software, you may select **Merge CSV files belonging to same log group** in the **Set Download Preferences** window.
2. When converting the log files, you may select **Merge files** in the **Convert Log Files** window.

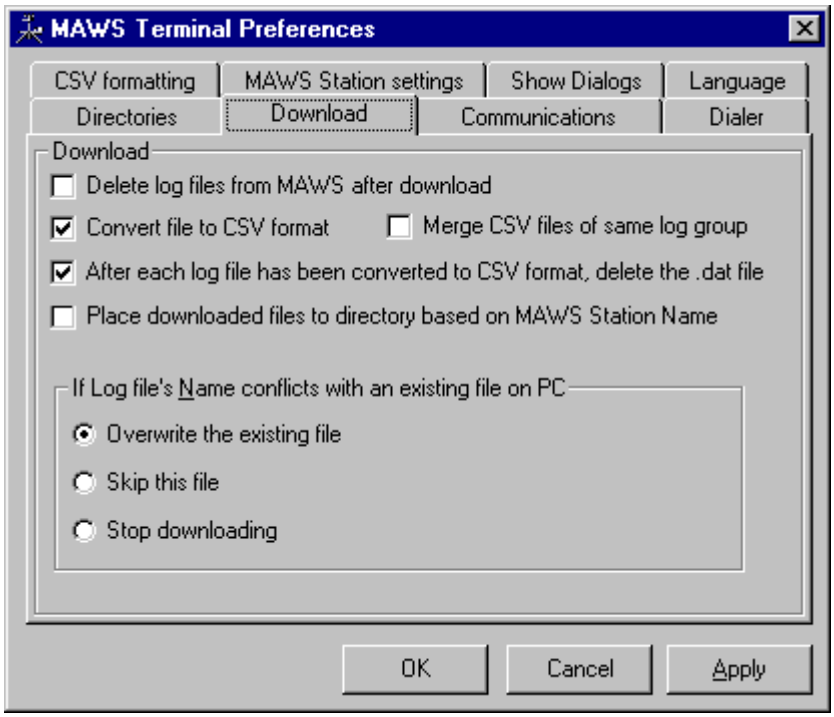


Figure 78 Download Tab in Preferences Window

Address Book Window

When you choose the **Address Book** option from the **Settings** menu, the following window appears.

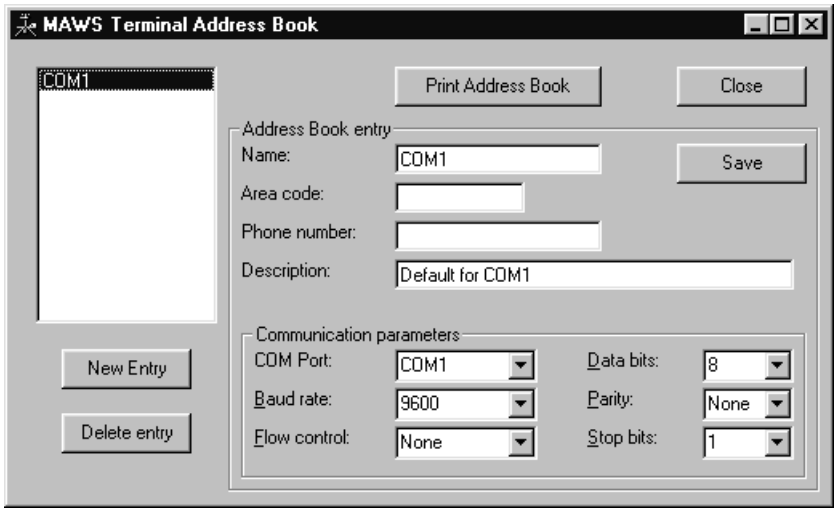


Figure 79 Address Book Window

In the **Address Book** window, you can define MAWS communication details. You can also define parameters for both directly connected stations and for stations that establish the connection via modem. You can add new entries and delete old ones.

Opening MAWS Service Connection

Before you can download files or upload the configuration file, you need to open the service connection to MAWS.

MAWS Terminal supports any number of serial ports available in the computer. The software reads from the registry of the Windows® operating system which serial ports are installed. The **Select Address Book entry** list reflects the serial ports that are available for selection. For an example, see Figure 80 on page 88. The user may select any applicable COM port from the list.

This feature enables even the usage of the USB to RS-232 converter cables that are usually installed above any other COM ports installed to a computer. The COM port number of such a converter cable depends on the system configuration. For example, in a desktop computer with only two physical COM ports (COM1 and COM2) a converter cable is installed as COM3.

When reassigning the COM ports after installation, for example, when changing COM5 afterwards to COM4 you need to manually recreate the address book entry for the modified COM port.

To establish a connection to MAWS, choose **Dial** from the **Connection** menu. You can also click the **Dial** icon. The **Select Address Book entry to dial** window appears, see Figure 80 on page 88.

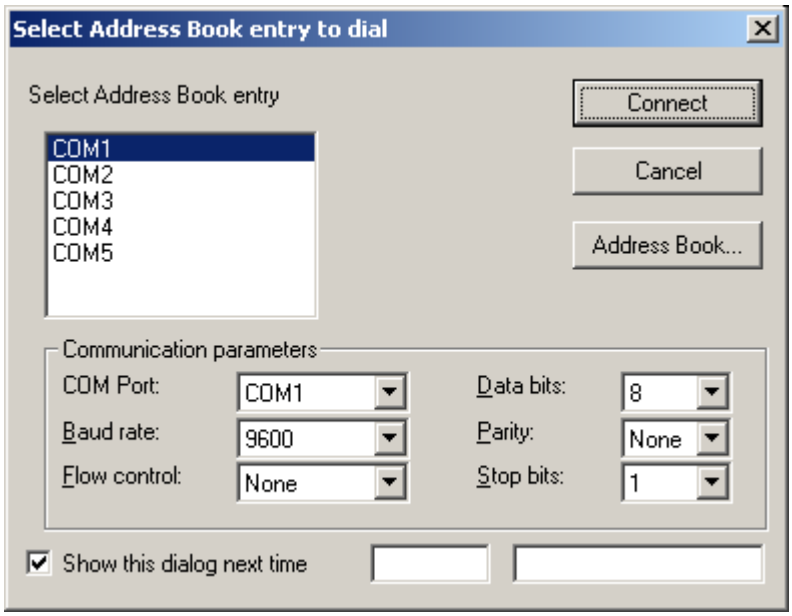


Figure 80 Select Address Book Entry to Dial Window

In the **Select Address Book entry to dial** window, select the port to which MAWS is connected and click **Connect**.

NOTE	Before connecting, the **Password Entry** window opens, if you have set the user level in your MAWS. For more information on setting the user levels, see section Managing User Levels on page 90.

When the connection is opened, you will see the following text on your screen.

```
Service connection opened
/>
```

NOTE	The next time you are opening a service connection, the address book window is displayed. The program does not automatically connect you to the port you previously selected. If you want that the address book window is not displayed every time you connect to MAWS, you can clear the **Show address book list before connecting** check box from the **Settings - Preferences - Show Dialogs**.

Giving Commands

When you have established the connection, you can use the commands (described in Table 18 on page 123) to communicate with MAWS. Commands are actually text sent from the PC or terminal to MAWS.

To open the connection, give the **open** command. To close the terminal connection, give the command **close**. Logging is not affected unless it is stopped using the **logstop** command. In closed mode, the serial line will be available for report sending.

NOTE Both **open** and **close** commands have to be typed exactly right before they can be executed. This means, you can not use the BACKSPACE key to correct your typing. Simply retype the command and press ENTER to give the command again.

Most of the commands can be used for both setting a value to some parameter or viewing the set value of the parameter.

Type **help** to get a list of the available commands. Each command must be entered using the correct syntax. You do not have to memorize any complex commands since at any time you can view a help text that shows the correct syntax. Just type **help** and the command name.

Table 10 Interpreting Help Texts (the Correct Syntax)

Generic Representation	Example		Note
Use the parameter name.	**warnings** [*clear*]	To see the warnings, type: **warnings**	Parameters shown in [ ] can be left out.
		To remove warnings, type: **warnings** *clear*	
Replace parameter symbols with values.	**time** [*HH MM SS*] [*YY MM DD*]	To see current time, type: **time**	
		To set new time, type e.g.: **time** *15 45 00*	
		To set new time and date, e.g.: **time** *15 45 00 03 06 18*	
	loggo <*group_id*>		Parameters shown in < > cannot be left out.

NOTE	Commands have to be typed in the same case as indicated in the help texts, usually in the lower case.

The command name and the following parameters are always separated by a space. Pressing ENTER (return) will execute the command so that MAWS reads the typed command.

You can use BACKSPACE to delete the last typed character.

Use CTRL+P (hold down the CTRL key and press P) to repeat the previously typed command. Use CTRL+P (Previous) and CTRL+N (Next) to scroll through the list of previously typed commands. When you find the command you would like to repeat, simply press ENTER. File commands (dir, del, copy, move, verify) can be aborted with CTRL+C.

Closing MAWS Service Connection

If your MAWS connection works via a modem, you must remember to close the line after you finish working with MAWS. To close the connection, choose **Hangup** from the **Connection** menu.

If your MAWS connection is direct, it is recommended that you close the service connection by entering the **close** command. The program closes the service connection automatically after 5 minutes.

Managing User Levels

You can use the **userlevel** command to protect the system from unauthorized use. The system provides three password protected access levels to the shell commands as well as to the visibility of system data. By default, the user levels are not in use.

CAUTION	Improper use of the **userlevel** command may lead to malfunction of the logger.

You can manage user levels by the **userlevel** command when the service connection is open. The command has the following syntax:

userlevel [*level <set/clear>*]

where

level	=	1, 3, or 5
set	=	Sets the password for a level
clear	=	Clears the password from the level

To check the current setting, give the command alone, without parameters. When you want to change the level, give the command with parameters. When you change the level to a higher one, a password is required. When you change the level to a lower one, a password is not required.

To change the password for the level, give the command with the appropriate level and the set parameter. For this operation, the effective user level has to be the highest, that is, 5. The change of the password becomes effective immediately.

To remove the password for the level, give the command with the appropriate level and the clear parameter. For this operation, the effective user level has to be the highest, that is 5. The change of the password becomes effective immediately.

CAUTION Setting a new or clearing an existing user level is effective only after resetting MAWS. When setting a new or clearing an existing level, be sure to reset the system before closing the service connection. Otherwise, you may not be able to access the system without the cold reset.

To check the allowed commands at the specific level, give the **help** command. Table 11 on page 92 lists the accessible commands in the different user levels. Level 1 provides access to the minimum set of commands and visibility of system parameters. Level 3 provides access to all commands needed for normal administration and commissioning.

Level 5 provides access to all commands. For the command reference, see Table 18 on page 123.

Table 11 Accessible Commands in Different User Levels

User Level	Commands
Userlevel 1	cd, copy, dir, errors, help, logshow, logshownext, logshowprev, logstatus, rep, warnings, and zs
Userlevel 3	EXTFS, LOGFS, altitude, battery, cd, chmod, copy, del, dir, errors, help, logdel, loggo, logshow, logshownext, logshowprev, logstatus, logstop, md, move, pslevel, rd, rep, reset, serial, sname, spclear, spset, time, timezone, verify, warnings, winddircal0, zr, and zs
Userlevel 5	All the userlevel 3 commands and the userlevel administrator rights.

Modifying Station Settings

In MAWS Terminal, you can modify the station settings. When you choose the **Set Stations Settings** option from the **Tools** menu, the window appears, see Figure 81 on page 92. Under **MAWS common parameters**, the separate fields are for setting the common parameters to a station. Table 12 on page 93 lists the items, which are changeable.

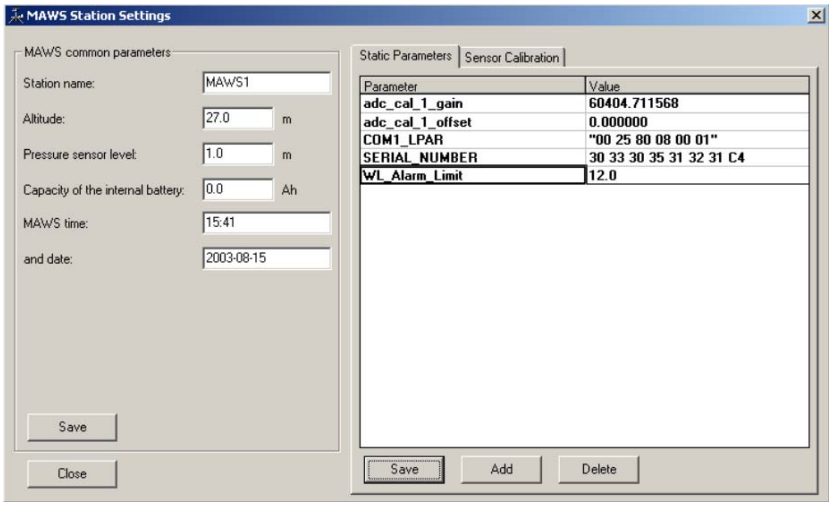


Figure 81 MAWS Station Settings Window

Table 12 Description of MAWS Station Settings Window

Item	Description
Station name	You can define a name for your station.
Altitude	Enter the altitude of the MAWS station from sea level.
Pressure sensor level	The height of the pressure sensor on the MAWS mast.
Capacity of the internal battery	Enter the capacity of the MAWS internal battery QMB101. Note that this value is set to zero when high capacity back-up batteries are included in the delivery, which is normally the case with the MAWS301 systems.
MAWS time and date	After you change the MAWS battery, you need to set the system clock. Type the correct time (HH:MM) and date (YY-MM-DD) in the appropriate fields and click **Save**.
Static Parameters tab	The list of the static parameters (depends on your configuration).
Sensor Calibration tab	The list of the connected sensors and the calibration values (depends on your configuration).
Manual Entry tab	The list of the manual sensors and their values is visible only when manual sensors are included in the setup (depends on your configuration).

Setting Static Parameters

To be able to use static parameters in MAWS, you must first create them in MAWS Lizard and then either use the default values given in MAWS Lizard or change the values in MAWS Terminal.

The MAWS Lizard Setup Software provides an interface for creating setup specific static parameters to be used, for example, as station dependent parameters or as calculation factors. This interface is in the **Setup Management** view and it is only available on the advanced user level.

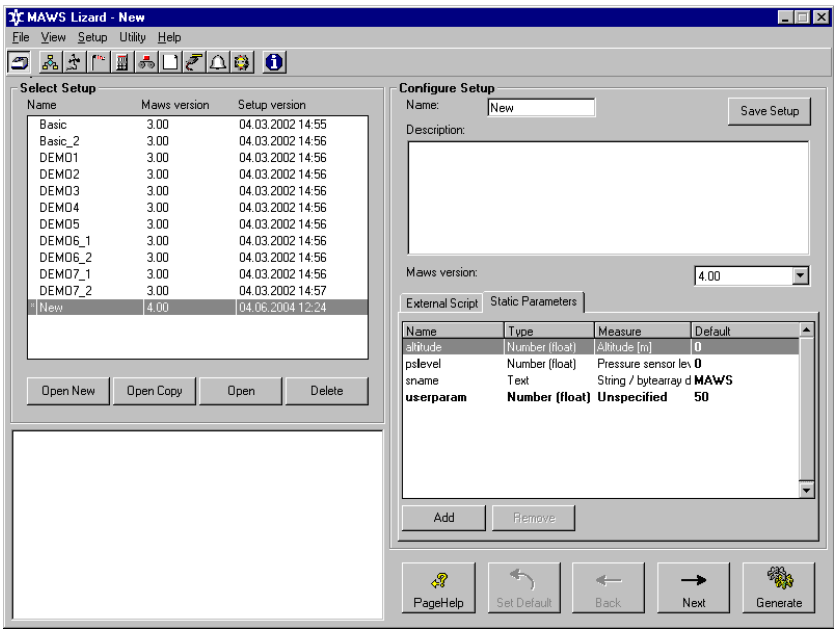


Figure 82 Setup Management View: Static Parameters Tab

The list under the **Static Parameters** tab shows all the static parameters, including the preset ones. Refer to Figure 82 on page 94. The user editable entries are listed in **bold**. The **Default** column shows the default values for each parameter.

NOTE The default value is written to the logger memory only when the static parameter does not have an existing value. For example, if the **sname** parameter already has the value *MAWS1* and a new setup is generated with **sname** = *MAWS2*, the existing sname value (*MAWS1*) is preserved.

To create a new static parameter, proceed as follows:

1. In the **Static Parameters** tab, click **Add**.
2. Give a name for the parameter. The name may consist of characters A...Z, a...z, 0...9, and _. No spaces are allowed.
3. Select a type for the parameter. The possible options, **Number (float)**, **Number (int)**, or **Text**, will appear by double-clicking the bold text in the **Type** column. Selecting the type will determine how the parameter is used. A text parameter, for example, cannot be used as calculation input.

4. If the parameter is numeric, it is recommended that you also select a measure unit for it. If the parameter will be used as a station specific calculation parameter, you should provide it with a correct unit, otherwise the calculation configuration may not allow you to use the parameter as input. If there is no suitable unit available, select **unspecified**. This causes the parameter to be applicable for all use.
5. Enter a default value for the parameter.

NOTE	All parameters are automatically created to the logger when the setup is uploaded.

The value of a static parameter, which can be a default value given in MAWS Lizard, can be changed in the **Station Settings** window of MAWS Terminal. The **Static Parameters** tab shows all the parameters and their values, also those that have been set directly with the MAWS Terminal software, see Figure 83 on page 95. To change the value of a static parameter, proceed as follows:

1. Start MAWS Terminal and select **Station Settings** from the **Tools** menu.
2. In the **Static Parameters** tab of the **Station Settings** window, double-click the corresponding **Value** cell. Enter the new parameter value.

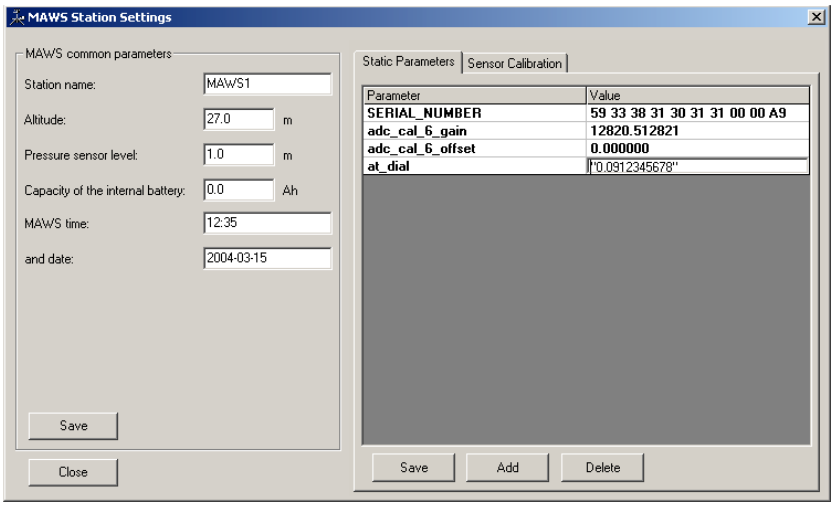


Figure 83 Terminal Station Settings Window

3. Click **Save** to store the new parameter value to MAWS. You can also change multiple values and save them all at once.

Calibrating Sensors

For calibrating the sensors with MAWS Terminal, the **Sensor Calibration** tab is available in the **MAWS Stations Settings** window, see Figure 84 on page 96. The list of the MAWS sensors is displayed in the tab.

NOTE You must load an appropriate setup to MAWS, before you are able to use the **Sensor Calibration** tab.

NOTE The **Sensor Calibration** tab is not visible for the setups made with the MAWS software versions prior to 3.06. With such an older setup, **MAWS common parameters** frame shows only the calibration values for the wind direction and solar radiation sensors, other sensors need to be calibrated through the terminal connection with the appropriate calibration commands.

CAUTION When you upgrade a previous MAWS version to 3.06 or above, the following sensors will not operate correctly in the **Sensor Calibration** tab until they are removed from the setup and then re-created: CM6B, CM11, QMS101, QMS102, and QMN101.

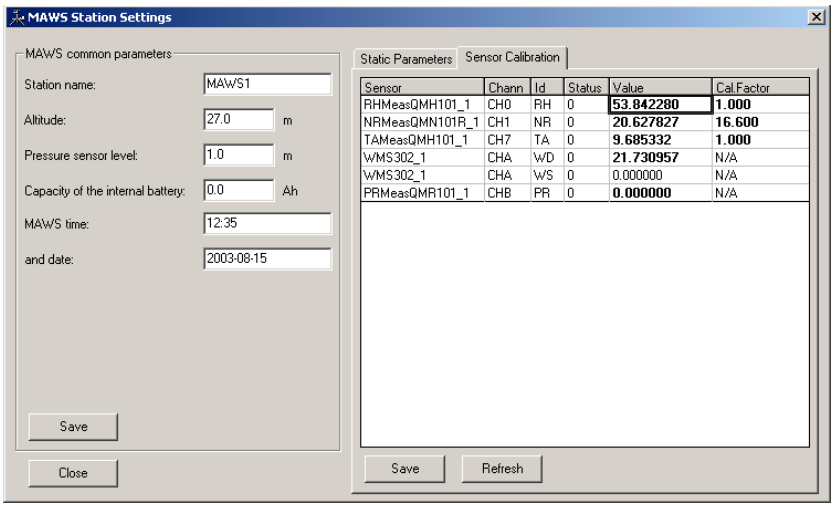


Figure 84 MAWS Station Settings Window: Sensor Calibration Tab

The list in the **Sensor Calibration** tab does not refresh automatically. To read the latest measurement values, click the **Refresh** button. You may enter new values to the cells that have bold font. You can not change the cells with N/A. Table 13 on page 97 describes the columns in the **Sensor Calibration** tab.

NOTE When **Value** is expressed as N/A, it indicates that the calibration factor has been altered but not saved, the sensor has not been measured or the measurement channel of it has failed, or the sensor is disabled. Further information about the possible reason can be obtained by comparing the value in the **Status** column against the values listed in Table 14 on page 99.

Table 13 Columns in the Sensor Calibration Tab

Column	Description	Input
Sensor	The sensor name as defined in the setup.	n/a
Channel	The measurement channel of the sensor.	n/a
ID	The measurement identifier	n/a
Status	The sensor status	n/a
Value	The last measured sensor reading shown in physical units.	Overwrites the sensor reading with the entered value, that is, changes the offset of the measurement.
Cal.Factor	The measurement gain for the sensors, except for the radiation sensors (QMN10x and QMS10x) the sensitivity value.	Overwrites the old gain value with the new one. For radiation sensors (QMN10x and QMS10x) changes the sensitivity value.

Calibration is done by entering the sensor specific **Value** and/or **Cal. Factor** parameters.

- The **Value** parameter affects the offset of the measurement. Entering the new value changes the sensor reading to the given value and the new offset for the measurement is set.
- The **Cal. Factor** parameter has sensor dependent use. It affects the gain of the measurement or the sensitivity of the radiation sensors. To calibrate radiation sensors QMN10x and QMS10x with MAWS, enter the sensor dependent sensitivity factor [V/Wm-2], which is given in the type sticker or calibration sheet of the

particular sensor. To calibrate other listed sensors, enter the gain of the measurement, that is, the slope of the conversion curve.

NOTE You can do either offset or gain calibration at a time. When you enter a new value in the **Value** or **Cal. Factor** field, the other parameter will be expressed as `N/A` until you save your changes. Note also that entering a new value in the **Value** field, for example, when performing offset calibration, will reset the gain to 1.000.

After you have changed the value(s), click the **Save** button in the tab to write the new values to MAWS.

NOTE New sensor calibration values are taken into use after resetting MAWS, for example, with the **RESET** command.

Sensor Status List

Table 14 Sensor Status List

Value	Meaning	Notes
0	The sensor is working properly (OK).	
1	Not measured yet	
2	Interface is not initialized.	1
3	Communication time out has occurred.	1
4	Unknown data is received.	1
5	Communication is functioning, but the sensor reports errors. Use sensor's own service interface to find out cause.	1
6	Sensor communication is paused because service connection is opened through MAWS.	1
7	Message sequence numbers are overlapping in the Autotrac satellite transceiver interface.	1
8 ... 19	Not available	
20	Excitation failure is caused by the overload in the excitation output.	2
21	The input voltage is out of range or the A/D conversion has failed due to an internal error.	2
22	Sensor is disconnected or the connection cables are broken.	2
23	Sensor output exceeds the min/max limits defined in the **Measurements** view.	2
24	Change in sensor output has exceeded the maximum step defined in the **Measurements** view.	2
25	An internal configuration error has occurred.	2
26	Error in reference measurement, which is usually caused by damaged sensor/logger or electrical interference.	2
27	Internal voltage error occurred or the logger is damaged.	2
28	PMT16 calibration data error.	2
29	Data is invalid for unspecified reason.	2
30	The measurement or the sensor has been manually disabled.	
99	Sensor status is not supported.	

1. Value is available only for the sensors with the serial interface.
2. Value is available only for the sensors with a conventional, that is, analog or counter/frequency interface.

Entering Values Manually

Before being able to manually enter data to MAWS using MAWS Terminal, you have to create and configure manual sensor(s) in MAWS Lizard.

Creating Manual Sensor in MAWS Lizard

In the **Equipment** view, select *ManualSensor* and click **Add**. *ManualSensor* is automatically connected to the **Console** connector, see Figure 85 on page 100.

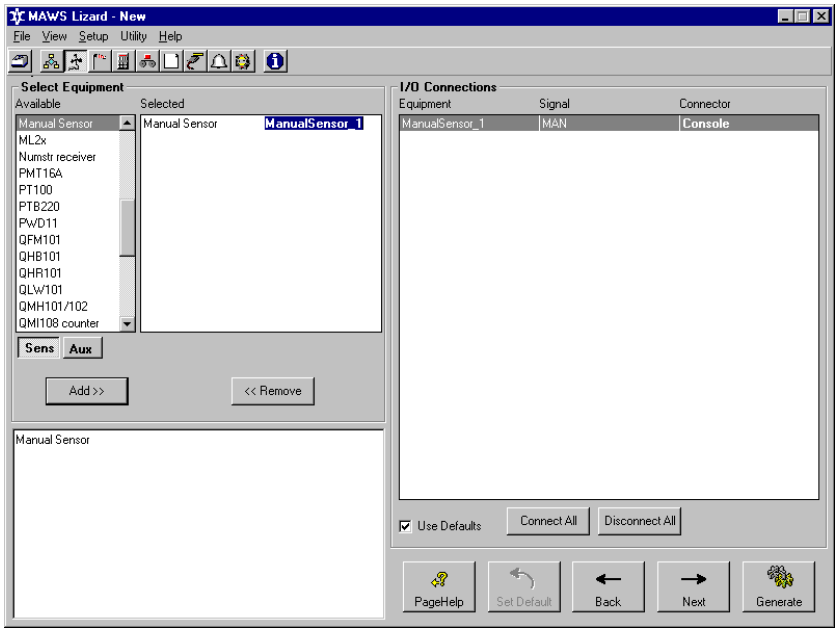


Figure 85 Creating Manual Sensor in MAWS Lizard

Configure the manual sensor to use the correct **Datatype**, **Validity period**, and so on, see Figure 86 on page 101.

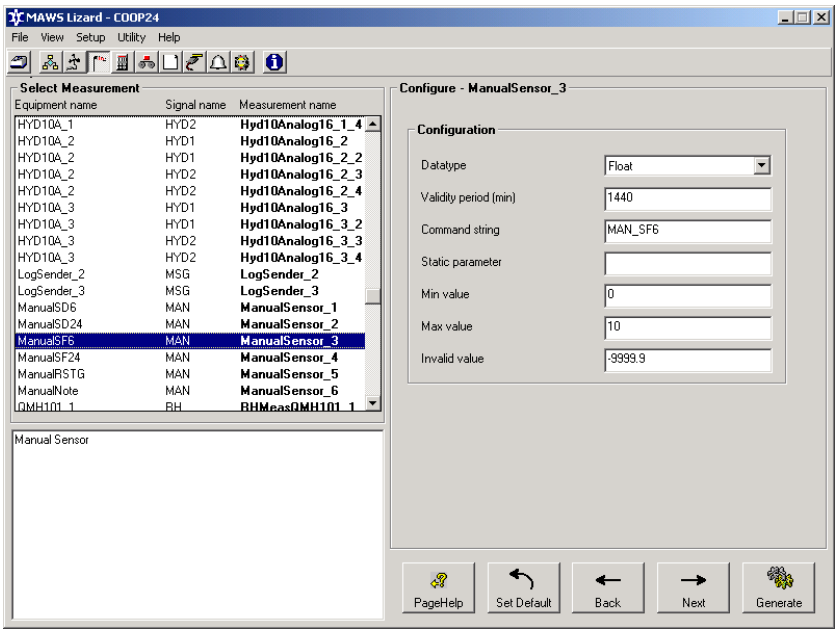


Figure 86 Configuring Manual Sensor in MAWS Lizard

Manual Entry in MAWS Terminal

In MAWS Terminal, the **Manual Entry** tab lists all the manual sensors, see Figure 87 on page 102. The **T** column shows the data type and the **St** column the status.

To enter values for the manual sensors:

1. To access the **Manual Entry** in MAWS Terminal, select **Station settings** in the **Tools** menu and the **Manual Entry** tab.
2. In the **Manual Entry** tab, select a manual sensor from the list and double-click the appropriate cell in the **Value** column to enter the correct value for the manual sensor.
3. Click **Save**, to save the changed value to MAWS.

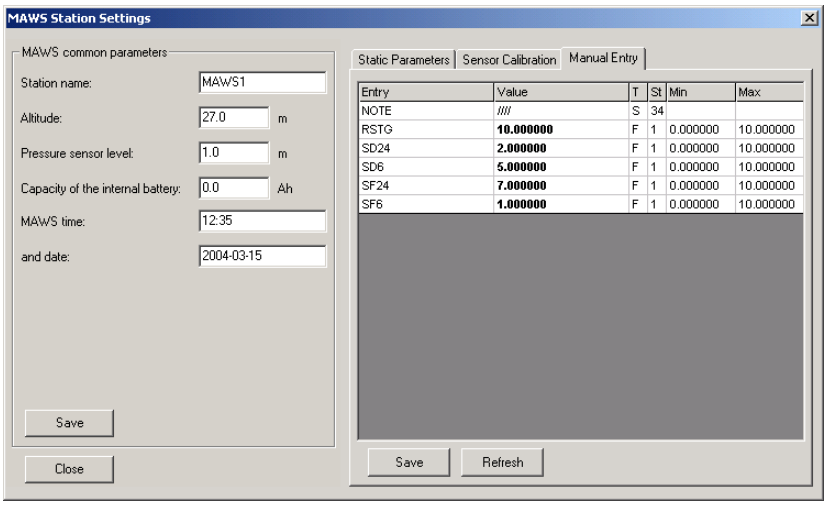


Figure 87 Manual Entry Tab

MAWS Configuration File

When you start using MAWS for the first time, you need to upload a configuration file from your PC to the MAWS station.

This configuration file includes all details required by the system to function properly: which sensors the system contains, which settings they use, to which MAWS channels they are connected, and how often they calculate weather parameters. The configuration file also defines the frequency at which MAWS logs data in a file and the number of days for which data log files are kept in MAWS memory.

For archiving the configuration files save them as .dtg files to a folder in a reliable backup device. For more information, refer to the MAWS Lizard Setup Software User's Guide.

Selecting Configuration File

The MAWS Lizard Setup Software comes with some ready-made configuration files from which you can choose the one to be used. You can select the file that best suits your system. The main difference between the configurations is that with some of them, the system measures weather data more frequently, logs more variables by having more sensors, and produces more reports.

You can modify one of the configuration files with the MAWS Lizard Setup Software to produce exactly the configuration you want. However, this requires a thorough understanding of the system. For more information, refer to the MAWS Lizard Setup Software User's Guide.

CAUTION If you create a configuration of your own by modifying the ready-made files, store the new file under a different name. This way, you can go back to the original configuration in case the new one is not working.

CAUTION Also notice that the settings you define in the configuration file must match the settings you make in the **Preferences** window and the **MAWS Stations Settings** window.

Uploading Configuration File

CAUTION When you upload a new configuration, the system erases all data log files from MAWS. Make sure you download the files you want to save before uploading the new configuration. For more information on downloading data log files, see section Selecting Files for Downloading on page 110.

You need to upload the MAWS configuration file in two occasions:

- When you start using MAWS for the first time.
- When your system has been updated, for example, new sensors have been added.

After a system update, the configuration file needs to be updated to match the changes. Normally, you need to modify the configuration file yourself with the MAWS Lizard Setup Software. After you have finalized with MAWS Lizard, you have to open the MAWS Terminal in order to be able to upload the configuration file as follows:

1. On the **Tools** menu, select **Upload Configuration**.
2. The **Select the configuration file for upload** window appears, see Figure 88 on page 104. Select the appropriate configuration file and click **Open**.

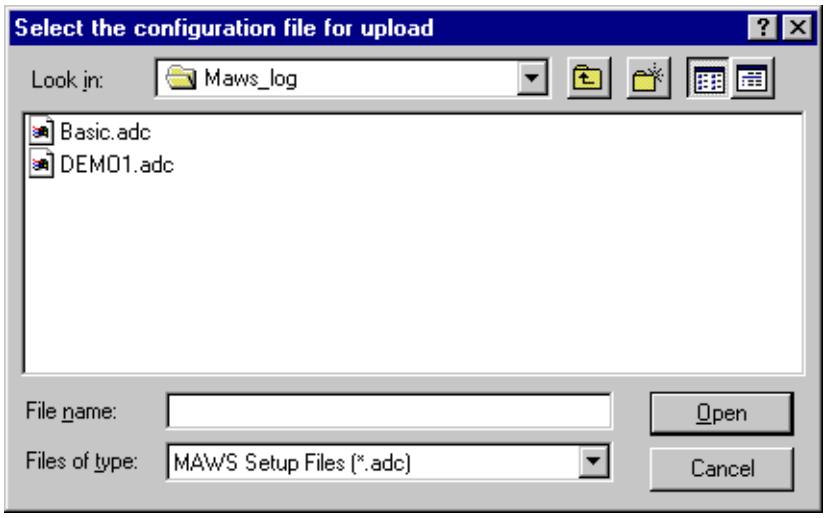


Figure 88 Selecting an Upload Configuration File

3. When the file has been transferred, MAWS starts executing the new setup according to the settings in the configuration file.

Data Logging

Logging means storing of the measured and calculated data in the MAWS internal memory, that is, to 2 MB Flash chip with the data storage capacity of 1.7 MB. Additionally, you may use an external memory card. For more information, see section Using External Memory Card on page 120. From the internal and external memory, logged data can later be retrieved, for example, via serial line.

Logged data is stored in the daily files, for example, L2010326.dat, which is a binary file. Naming convention is the following:

- All log files begin with the name of the log group. The log group name consists of a letter followed by a number, that is, L0, L1, L2, L3, and so on.
- The log group name is followed by the date in the YYMMDD format.

Everything that MAWS measures and calculates, it can also log in its Flash memory. Approximate log memory capacity can be checked and also printed in the **Setup information** view in MAWS Lizard when a

setup is created. The approximate maximum logging period for a setup where 10 measured values are logged is shown in Table 15 on page 105.

Table 15 Log Memory Capacity

Logging Interval	Maximum Logging Period
1 second	5 hours
10 seconds	over 2 days
1 minute	2 weeks
10 minutes	over 4 months
1 hour	Almost 2 years

Log files are automatically deleted after a given period so that there is always a certain amount of logged data saved in the Flash memory. The period is adjustable in a setup and can vary from 0 (= at midnight, the previous day's file will be deleted to free up memory) to never delete (=log memory will be filled up completely). To ensure some data backup, for example, a value of 4 days is feasible. If the delete interval is set negative with the MAWS Lizard Setup Software, the old log files will not be deleted automatically.

Log Data Format

A log entry is generated at the time defined in the setup file. When entries are retrieved with the **logshow** command, the produced output includes two parts: the header and the log entry information.

In Figure 89 on page 106, the example of a log query shows 10 entries of logged items 1 and 2 starting at 6 o'clock on December 9, 2003.

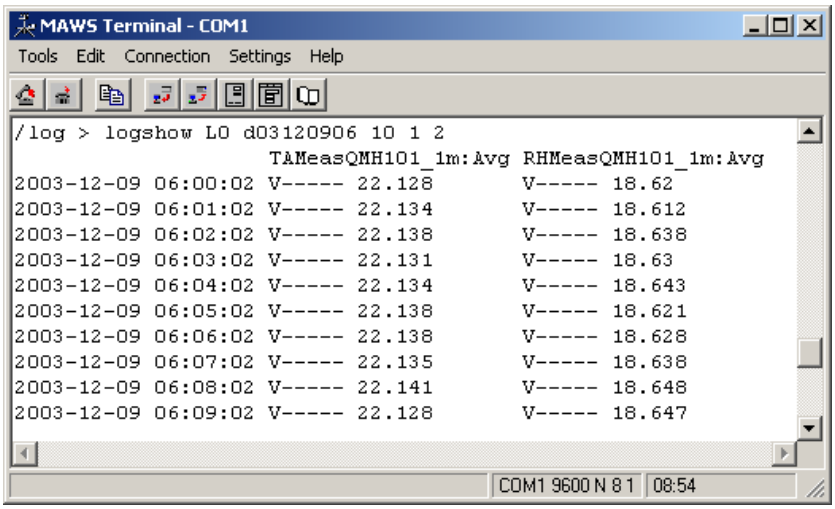


Figure 89 Output of the Logshow Command

The header information shows the variable name (TAMeasQMH101_1m:Avg and RHMeasQMH101_1m:Avg).

The log entry information includes the time tag, that is, date and time of the entry, the status, and the value of the logged measurement or calculation.

Table 16 Log Entry Status

Status Indicator	Status	Description
-I-----	Invalid	Value may be outside the set scale; that is, set climatological limits or step change validation.
-I--N-	Invalid; not available	No measurements done yet.
V-----	Valid (normal)	Measurement or calculated value available normally.

Controlling Logging

Logging is automatically on if it has been defined in the setup and if it has not been stopped. The logging is automatically stopped when the log file is retrieved with MAWS Terminal. When download is accomplished, the logging is activated again automatically.

When a sensor is replaced, stopping is not necessary if some invalid log items can be tolerated. Alternatively, instead of stop logging, you may

manually disable a measurement or a sensor. For detailed information, see section Measurement Enable or Disable on page 107.

To see the logging groups, type **logstatus**. To see the current logging status of a certain group, type **logstatus** <*group_id*>. To stop or start logging of a certain group, type **logstop/loggo** <*group_id*>. For the output of the commands, see Figure 90 on page 107.

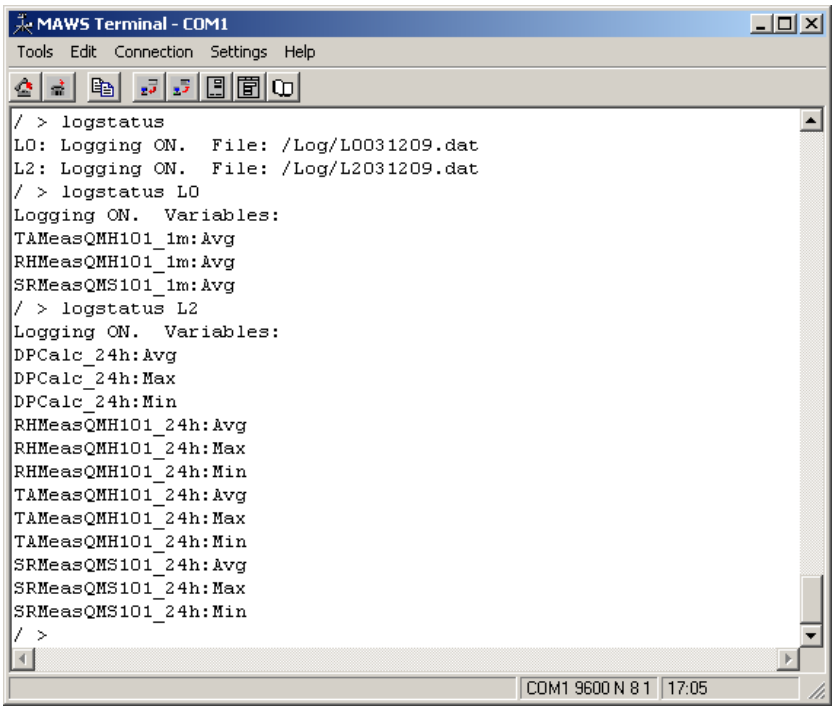


Figure 90 Output of the Logstatus Command

Measurement Enable or Disable

You can manually enable or disable all measurement inputs and sensors. You can use this feature for example to:

- Change remotely the readings of a faulty sensor to be flagged as invalid.
- Mark all sensor readings invalid during the maintenance operation.

Use the following commands in the service connection to change the flagging:

enable <*Measurement Name*>

disable <*Measurement Name*>

where

enable	=	Enables the measurement inputs or sensors.
disable	=	Disables the measurement inputs or sensors.
Measurement Name	=	The measurement name from the **Configuration** view of MAWS Lizard.

NOTE For the sensors, that use more than one input channel, you need to enter separate commands for each measurement. For example, you need to control separately the TA and RH measurements of the QMH101 sensor.

Examples:

```
>\ disable RHMeasQMH101_1
>\ disable TAMeasQMH101_1
>\ disable WMS302_1
>\ enable PWD10_1
```

Upon successful completion of the commands MAWS return:

```
Successfully disabled
```

or

```
Successfully enabled
```

Any other returned values indicate an error.

When the measurement input is disabled:

- All other output values than status have undefined values.
- Sensor status shows `disabled`, refer to the updated list of the sensor statuses in Table 14 on page 99.
- Value status shows `INVALID` and `NOT AVAILABLE`.

Freeing Up Logging Space

A log file can be deleted with the **logdel** command:

logdel <*log_group_id*> <*(dYYMMDD)*>

where

logdel	=	The command to delete log files, that belong to a certain log group.
log_group_id	=	The name of the log group, that is, L0, L1, L2, or so on.
dYYMMDD	=	The date until which the log files will be deleted.

Example:

```
/ > logdel L2 d980910
```

To erase all data in the log system, type **LOGFS** *ERASE*. This command erases the whole Flash memory and resets MAWS. The command **LOGFS** *ERASE* is necessary to free space for new log data.

CAUTION Erasing the log memory with **LOGFS** *ERASE* command is strongly recommended when changing a setup. First, load a new configuration and make sure it is operating correctly. Check that you have retrieved all the necessary information from the log memory, then erase the log memory.

Working with Data Log Files

The most convenient way to view the logged data is to use MAWS Terminal. To do this, you need to open the service connection, download the files from MAWS to your PC and convert them to CSV (Comma Separated Value) format. After conversion, you can view the files directly in MAWS Terminal or, for example, in Microsoft Excel.

Before you start downloading files, you need to open the service connection by choosing the **Dial** option from the **Connection** menu. For more information on opening the connection, see section Opening MAWS Service Connection on page 87.

Selecting Files for Downloading

When you have opened the service connection to MAWS you are working with, you need to select the data log files you want to download. Choose the **Download log files** option from the **Tools** menu. The **Select Log Files for Download** window appears.

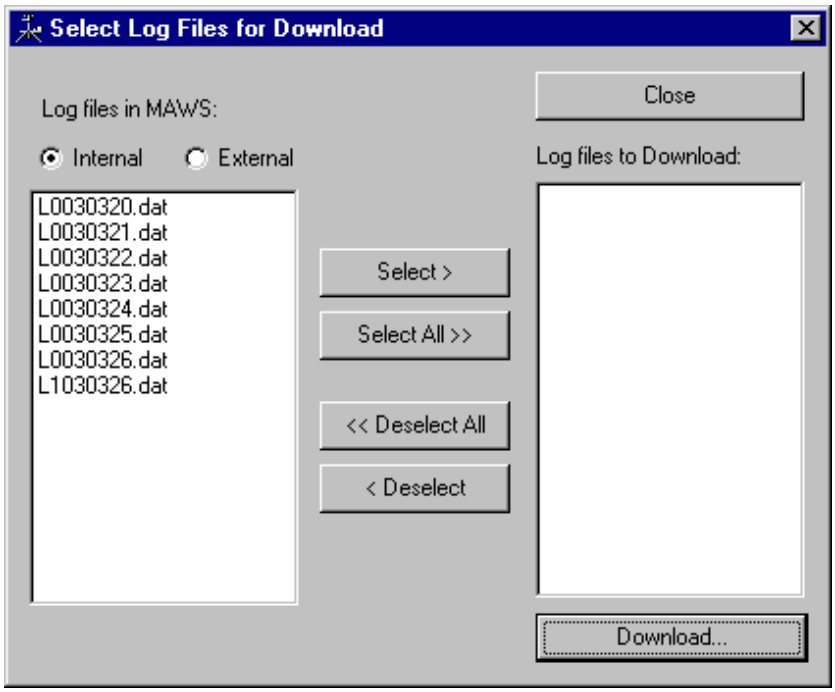


Figure 91 Select Log Files for Download Window

In the **Log files in MAWS** list, you see all data log files currently available in MAWS. The files are arranged by log group. Each log group includes specific parameters as defined in the configuration file.

Select the files you want to download and click **Select**. The files available for download, appear in the **Log files to Download** list. If you use an external memory card, select the **External** option. You can select all files by clicking **Select All**.

If you decide not to download a file after all, you can remove it from the **Log files to Download** list by selecting it and clicking **Deselect**. To remove all files, click **Deselect All**.

NOTE The program closes the service connection automatically after 5 minutes. If you fail to start the download within 5 minutes of selecting the **Download log files**, you need to reopen the MAWS Terminal program and start the download again.

Downloading Files

When you have selected the files you want to download, click **Download**, see Figure 91 on page 110. The **Set Download Preferences** window appears (unless you have defined otherwise in the **Preferences window - Show Dialogs** tab).

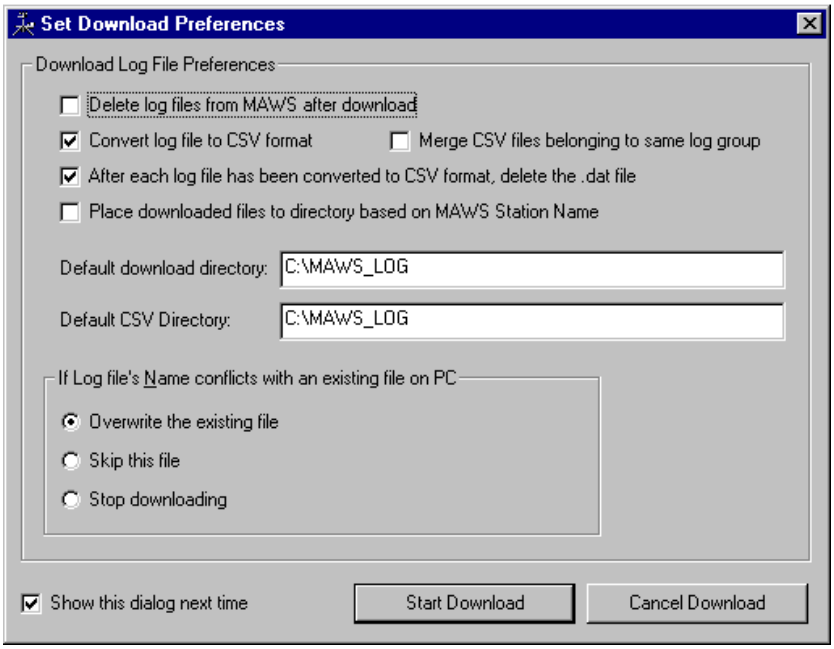

Set Download Preferences
Download Log File Preferences
Delete log files from MAWS after download
Convert log file to CSV format
Merge CSV files belonging to same log group
After each log file has been converted to CSV format, delete the .dat file
Place downloaded files to directory based on MAWS Station Name
Default download directory:
C:\MAWS_LOG
Default CSV Directory:
C:\MAWS_LOG
If Log file's Name conflicts with an existing file on PC
Overwrite the existing file
Skip this file
Stop downloading
Show this dialog next time
Start Download
Cancel Download

Figure 92 Set Download Preferences Window

The above window shows you the settings you have defined for the download. If you want to change any of them, you can do it in this window. Then click **Start Download**. When the **Convert log file to CSV format** is selected, the program downloads the data log files to your PC and converts them to CSV format automatically.

In addition, you may select **Merge CSV files belonging to same log group** to merge the downloaded data files to one file. The log files are merged by the log group. The log group is indicated by the two characters at the beginning of the file name, for example, L0, L1, L2, or L3. The name of the merged file will be: `L0firstfilename - L0lastfilename.csv`.

If you have selected that the data log files will be deleted from the MAWS memory after download, the program asks you to confirm this.

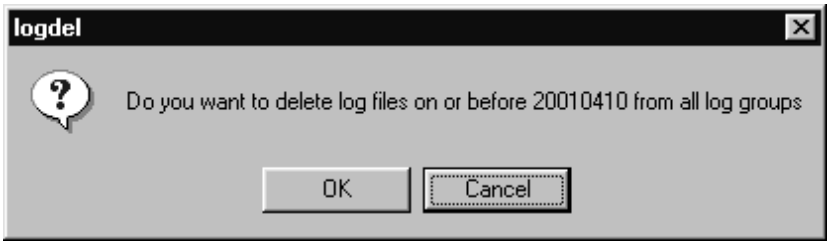


Figure 93 Confirming File Deletion after Download

CAUTION If you select **OK**, all files up to the mentioned date will be deleted, regardless of whether they have been downloaded or not.

Autodownloading Log Files

You can run MAWS Terminal in the AutoDownload mode. This mode allows you to download Log files automatically according to a user-defined schedule.

Before you change the application to the AutoDownload mode, a schedule must be defined. That is done with the window appearing when selecting **Settings - AutoDownload schedule**. The AutoDownload Schedule window is shown in Figure 94 on page 113.

In the **AutoDownload Schedule** window, you can define which stations to dial, when, and which Log files to download.

NOTE You must have the MAWS Terminal software running all the time to enable autodownloading. In addition, the COM port must be free and assigned for MAWS Terminal.

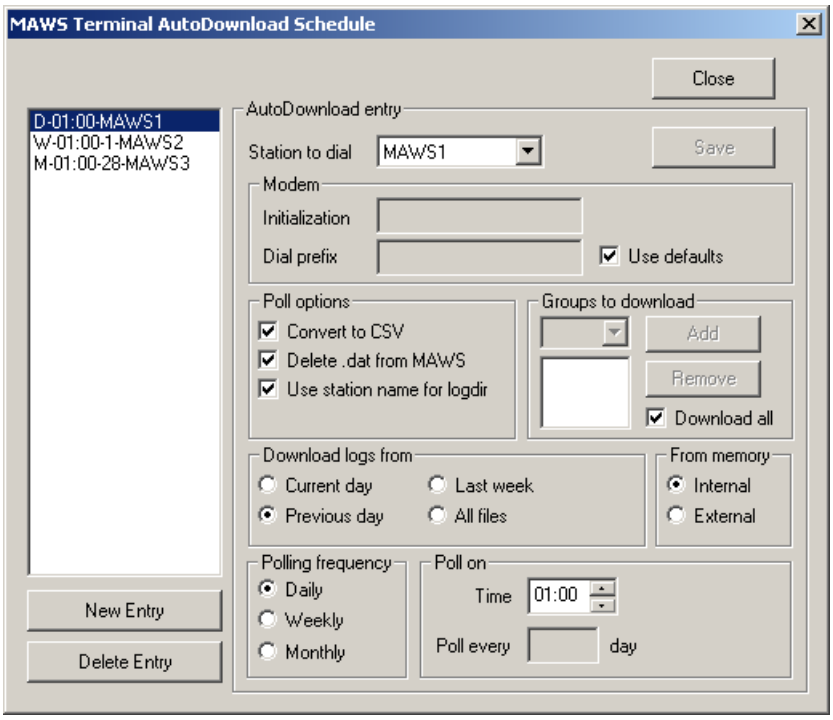


Figure 94 AutoDownload Schedule Window

When a station is equipped with a modem, you can either use the default modem initialization and dialing strings saved in Address Book or override them. You can enter the **Initialization** and **Dial prefix** values separately for each station.

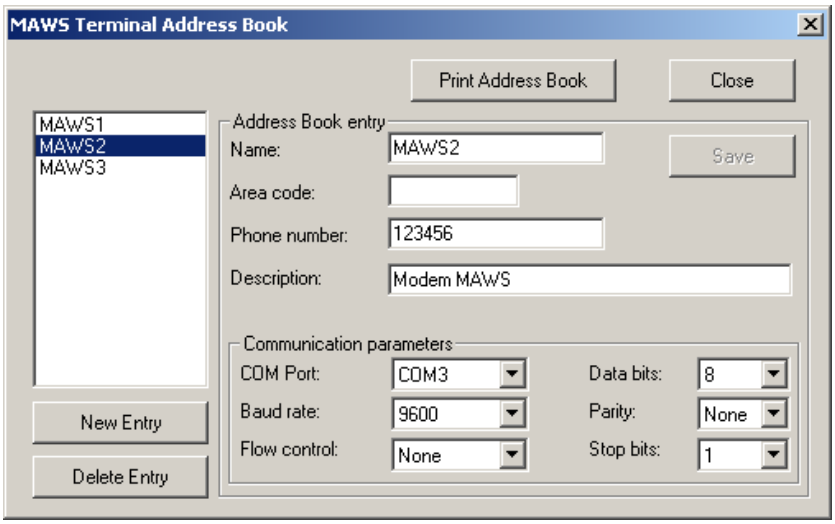


Figure 95 Address Book Entry for Modem Connection

Figure 96 Modem Options

When the phone number is entered into the **Phone number** field of the Address Book, the dial prefix entered in the **Dial prefix** field will be added to it. If the command which would be given manually in a terminal session is **ATD123456**, it is divided into a phone number (123456) and a prefix (ATD), see Figure 95 on page 113 and Figure 96 on page 114.

The scheduling of downloads is defined under **Polling frequency** as follows:

Daily – for scheduling a daily download from a station, at a certain time. You can set multiple daily polling times for one station. For example, in Figure 94 on page 113, the station called MAWS1 is polled daily at 01:00. The D character in the entry list stands for daily.

Weekly – for scheduling a weekly download from a station, at a certain time of day. The **Poll every … day** field will be active, accepting values from 1 (Monday) to 7 (Sunday). You can set multiple weekly polling times for one station. For example, in Figure 94 on page 113, the station called MAWS2 is polled weekly on Monday (1st day) at 01:00. The W character in the entry list stands for weekly.

Monthly - for scheduling a monthly download from a station, at a certain time of a day of a month. The **Poll every … day** field will be active, accepting values ranging from 1 to 31. You can set multiple monthly polling times for one station. For example, in Figure 94 on page 113, the station called MAWS3 is polled every 28th day of the month at 01:00. The M character in the entry list stands for monthly.

CAUTION	If there will be a download scheduled on the 31st day of a month which has only 30 days, the download will not be made on that month.

Once you have set the schedule parameters, select **Connection - AutoDownload mode**. Selecting this item will open the **Operating in AutoDownload mode** window, see Figure 97 on page 115.

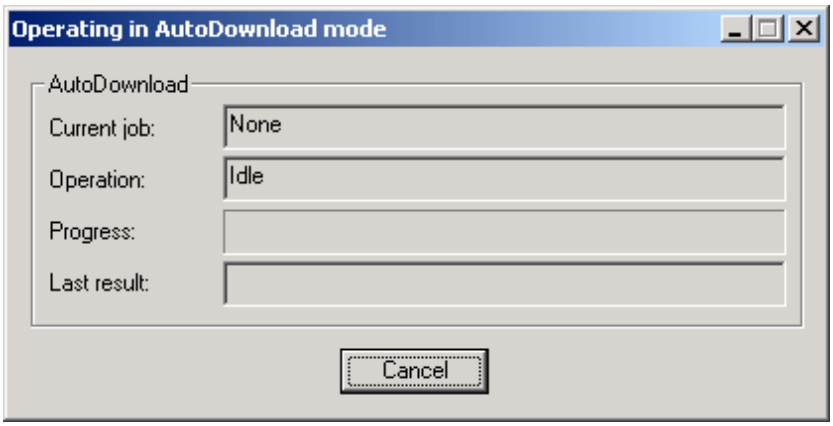


Figure 97 Operating in AutoDownload Mode Window

The application will wait in idle mode until the polling is triggered. When polling, the application automatically opens service connection to a station and downloads the Log files as defined by the user, see Figure 98 on page 115.

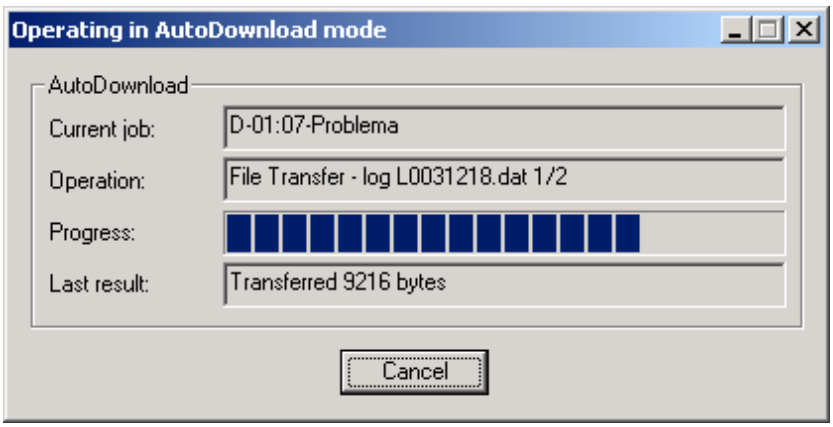


Figure 98 AutoDownload in Progress

When the log files are downloaded, the connection is closed and the application continues to wait in idle mode until a new pre-scheduled polling event is triggered. The **Last result** field displays **Session completed successfully** if all the tasks are accomplished without any problems, see Figure 99 on page 116.

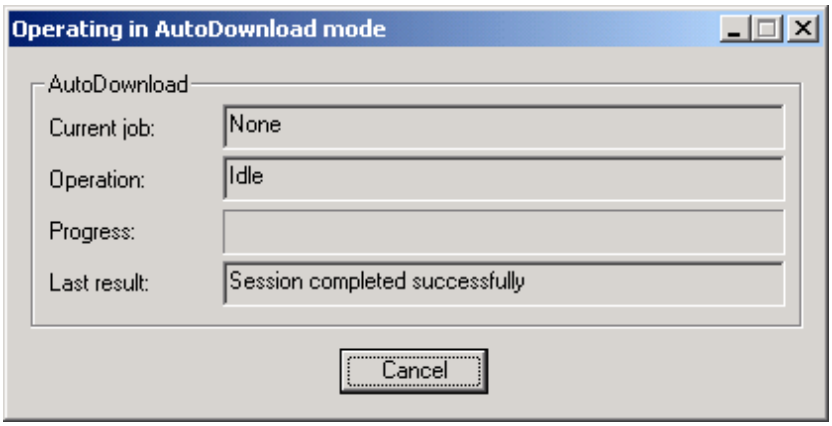


Figure 99 AutoDownload Completed

When you click the **Cancel** button in order to close the window, a work report will be shown, see Figure 100 on page 116. The **Info** window shows which stations were polled and the results of polling.

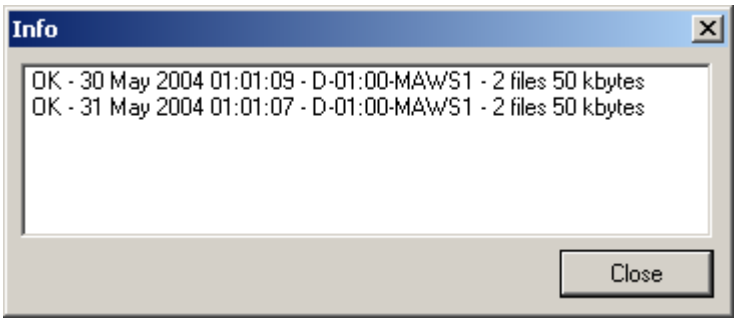


Figure 100 AutoDownload Info Window

Browsing Downloaded Files

You can browse the downloaded data log files directly in MAWS Terminal.

Choose the **Offline Log Query** option from the **Tools** menu. The window shown in Figure 101 on page 117 appears.

The default directory for data log files, is the one you have specified in the **Preferences** window under the **Directories** tab. If the files you want to browse are located in some other directory, click **Change Directory**.

From the **Select Log Group** list, select the log group containing the file you want to work with. The files in that log group appear in the **Select**

Log Files box. Select the files you want. If you want to limit the number of data items on your screen, click **Select Data Items**.

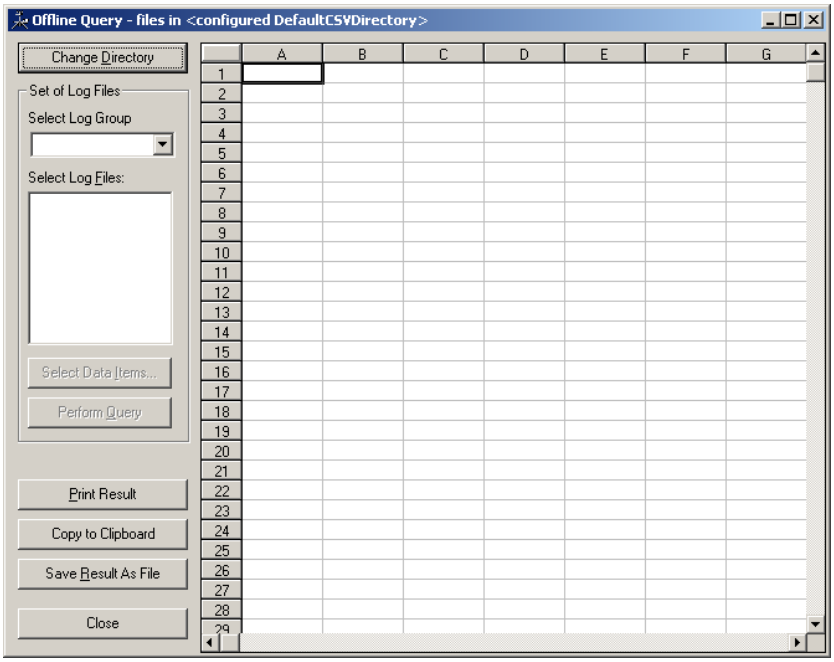


Figure 101 Offline Query Window for Browsing Data Log Files

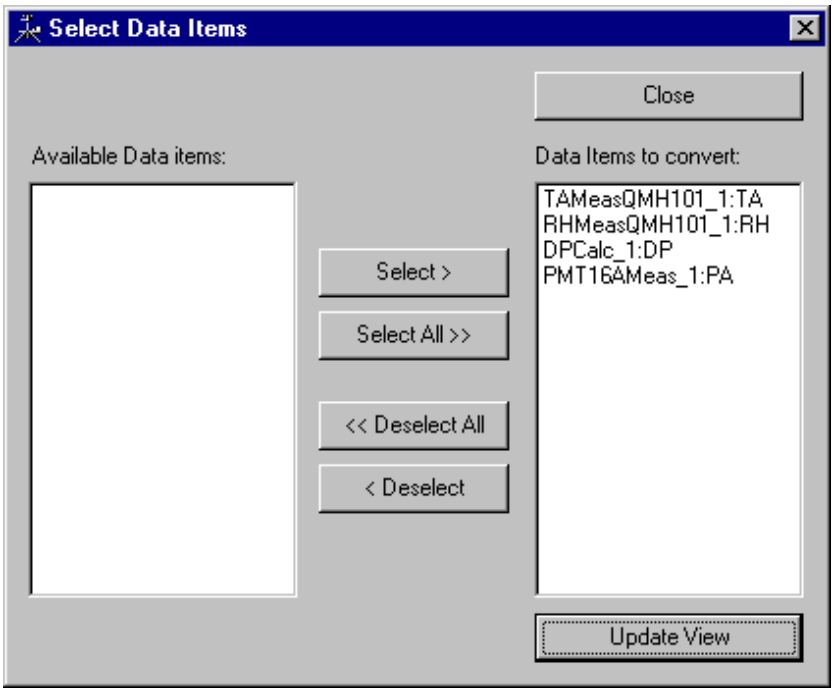


Figure 102 Select Data Items Window

In the **Select Data Items** window, you can select the data items you want to browse. All data items are selected by default. You can deselect any data item, or deselect them all. Once the data items you want are gathered in the right box, click **Close**.

Click **Perform Query**. The data items you selected appear on your screen in table format.

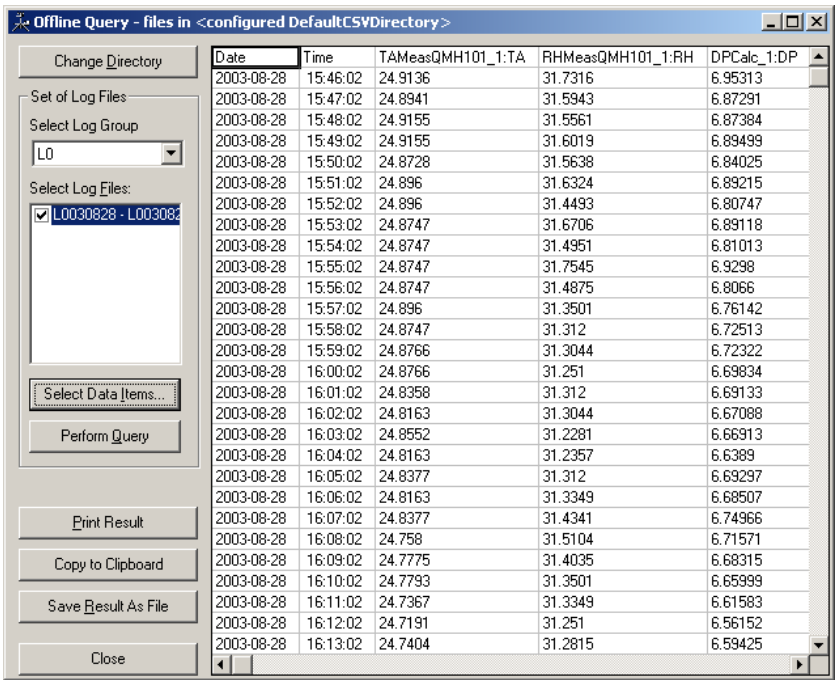


Figure 103 Offline Query Window with Data Items

If you want to view the table in Microsoft Excel, you must first save it in a tab-separated format. Click **Save Result as File**. In the window that appears, you can enter the filename and save the file in the directory of your choice. The default directory is the **Default download directory** you have specified in the **Preferences** window under the **Directories** tab.

When you have finished browsing the data log file, click **Close**.

Converting One Data Log File to CSV Format

If you have selected the **Convert file to CSV format** option in the **Preferences** window, in the **Download** tab, the program converts the data log files into CSV format as you download them. However, if you prefer to download the files without converting them, you can convert

them afterwards by choosing the **Convert Files to CSV** option from the **Tools** menu.

When you select the **Convert Files to CSV** option, the following window appears.

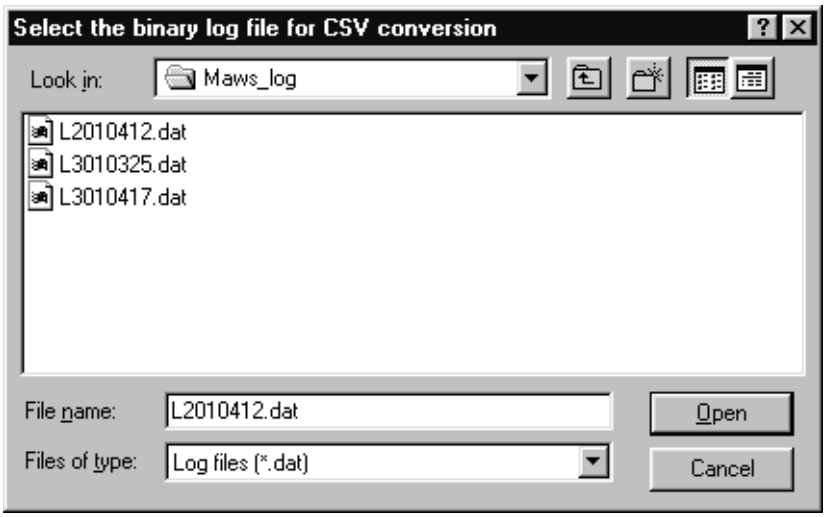


Figure 104 Selecting a Binary Log File for CSV Conversion

Select the file you want to convert to CSV format and click **Open**. The program starts the conversion. When the conversion is complete, the CSV file is saved in the directory you have specified in the **Preferences** window under the **Directories** tab.

Converting Several Data Log Files to CSV Format

If you prefer to download the files without converting them, you can convert several files afterwards by choosing **Convert many files to CSV** in the **Tools** menu.

When you select **Convert many files to CSV**, the following window listing the available log files appears.

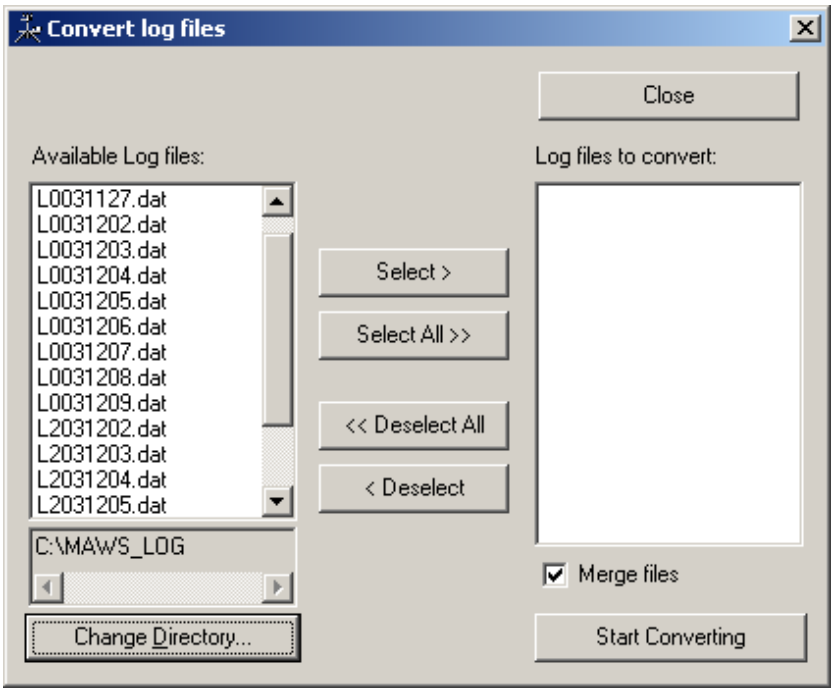


Figure 105 Converting Several Log Files to CSV Format

In the **Convert log files** window, you can select one by one the log files you want to convert, or select them all. Additionally, you can merge the files by selecting the **Merge files** option. Once the log files you want to convert are in the **Log files to convert** list, click **Start Converting**.

When the conversion is complete, the **Info** window appears. It shows which CSV files are created and whereto they are saved.

Using External Memory Card

The external memory card is used to store log files that have been copied or moved from the internal log directory. The data can be retrieved from the external memory card via terminal connection or by switching the memory card with an empty one.

Note that the memory card must be formatted with a command **EXTFS** *ERASE* before use.

The external memory card can be removed from MAWS for data retrieval without interruptions to MAWS operations. MAWS copies data from the internal log directory to the memory card daily at midnight, the default time is 00:00:30. The data is being written, when

the LED on the logger cover to the left of the external memory card is constantly on.

CAUTION The memory card must not be removed from MAWS while data is being written or the data may be lost. By default, data is transmitted to the memory card every day at 00:00:30.

When a new memory card is inserted into MAWS, the software checks that the card is ready for use. The status of the memory card is indicated by a LED. Table 17 on page 121 describes the different blinking sequences and the card conditions they indicate.

Table 17 LED Blinking Sequences and Card Status Options

Blinking Sequence	Card Status
Long-long	The card is OK.
Constantly on	Data is being written.
Short-short-short for 5 seconds	The card is unformatted or corrupted.

Automatic Erase from External Memory Card

The log group specific setting **Number of days to preserve log files** affects also the files stored to the external memory card. The functionality is the same as for internal log memory, that is,

- Files older than the selected value [*days*] will be deleted automatically
- Files are not erased, that is, the automatic clean up is disabled

When files are stored to the external memory card, the internal memory is used as the working memory for storing the log files of the current day. These working files are moved to the external card each day just after midnight when the new files have been created for writing.

Resetting MAWS

To reset MAWS, give the command **reset** (recommended) or press the reset button, see number 1 in Figure 106 on page 122.

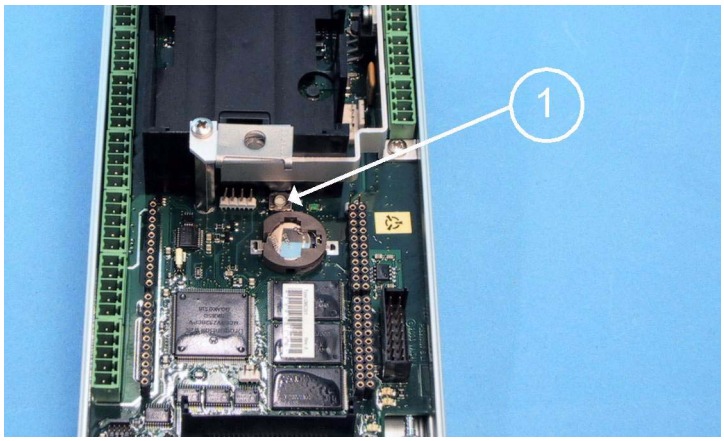


Figure 106 Reset Button on Logger

A short reset (pressing the reset button quickly) performs the same reset as giving the command and starts the program again. A long reset (pressing the reset button and keeping it down for a few seconds) restarts the program with a so-called blank setup. A blank setup does not run a configuration file.

The blank setup may be useful if configuration is somehow defective and does not allow the user to open a terminal connection. When the blank setup is run, MAWS communication parameters are restored to their defaults: COM0, 9600, N, 8, N, 1.

Command Reference for Terminal Connection

Table 18 Command Set

Command	Description
altitude	altitude [*meters*]. To see the current station altitude, type **altitude**. To change the altitude, type **altitude** and the new station altitude in meters from sea level.
battery	battery [*capacity*] sets the capacity of the internal battery, needed for MAWS internal control. Accepted capacity values are 1.2 ... 24 Ah. To see the battery status, type **battery**. Note that the **battery** command applies only to the internal battery.
cd	cd [*directory path*] changes the current directory. **cd /** gets you back to the root directory. NOTE! cd .. Cannot be used.
chmod	chmod <*filename*> <*r/w/x*> changes the file access attributes: read (r), write (w) or execute (x). The setup file "Basic/Advanced/Lowpower" needs to have attributes rwx.
close	Closes terminal connection.
copy	copy <*source file*> <*destination file*> copies a file to another location.
del	del <*filename*> deletes a specified file. Only files that have (w)rite access attribute can be deleted (see command chmod).
dir	dir [*file/path*] displays a list of a directory's files and subdirectories, used and free disk space. The file information includes name, access_attributes, time, date and size.
disable	disable [*Measurement Name*] disables the measurement input or sensor.
enable	enable [*Measurement Name*] enables the measurement input or sensor.
errors	errors [*clear*]. To see active errors, type **errors**. To clear active errors, type errors clear. Errors indicate that there is something wrong in the software.
EXTFS	EXTFS <*INFO*|*ERASE*>. To format Compact Flash card, type **EXTFS** *ERASE*. To show card info, type **EXTFS** *INFO*. NOTE! The command must be written in upper case.
help	help [*command*] displays a command syntax. To list all the available commands, type help.
LASTVAL	LASTVAL [*Measurement*] [*raw* | *Signal name*] shows the measured value before any validation and the status produced during validation. The validated value is shown when you give the signal name that is defined in MAWS Lizard.
logdel	logdel <*log_group_id*> <*lastdate (dYYMMDD)*> deletes a log file/files dated earlier than the last given date.
LOGFS	LOGFS <*ERASE*> erases all data in the log system and resets MAWS. NOTE! The command must be written in upper case.
loggo	loggo <*log_group_id*> starts logging of the defined log group.
logshow	logshow <*log_group_id*> [*start (YYMMDDHH)*] [*count*] [*item numbers*] **logshow** *L1*shows one line of current day; **logshow** *L1 40* shows 40 lines; **logshow** *L1 40 3* shows 40 lines of item 3; **logshow** *L1 030618 10* shows 10 lines starting from 18.06.2003
logshownext	logshownext <*log_group_id*> [*count*]. After the **logshow** command, can be used to show the immediately following (later) log entries.

Table 18 Command Set (Continued)

Command	Description
logshowprev	logshowprev <*log_group_id*> [*count*]. After the **logshow** command, can be used to show the immediately preceding (earlier) log entries.
logstatus	logstatus [*log_group_id*] shows logging state and variables of the defined log group. The command without parameters shows statuses of all log groups.
logstop	logstop <*log_group_id*> stops logging of the defined log group.
md	md <*path*> creates directory. E.g. **md** */Ext/logdata*
move	move <*source file*> <*destination file*> copies a file to another location and removes the source file.
open	Opens the terminal connection.
pslevel	pslevel [*meters*]. To see the current pressure sensor level, type **pslevel**. To change the pressure sensor level, type **pslevel** and the new pressure sensor level in meters from the station altitude.
rd	rd <*path*> removes directory
rep	rep <*report_name*> shows contents of a report report_name. E.g. **rep** *MyRep0*
reset	reset [*delay (seconds)*] resets MAWS (warm boot). If the delay time is not typed, MAWS resets immediately.
serial	serial <*port_number*> [*speed*] [*parity*] [*bits*] [*stop*]. To see the settings of the port number 0, type **serial** *0*. To change the settings, type **serial** *0* and the new parameters. E.g. **serial** *0 9600 N 8 1*. Available ranges/options: Speed 300-19200, Parity N/O/E, Bits 7/8, Stop 0/1.
SLEEP	Sets MAWS in low power-state. Use the **SLEEP** command to reduce power consumption when storing the station for a few days (maximum period 1 month). Tip the spoon of the rain gauge to wake up MAWS. MAWS can also be woken up by pressing the reset button. NOTE! The **SLEEP** command must be written in upper case.
sname	sname [*station_name*]. To see the current station name, type **sname**. To change the name, type sname and the new name. If the station name begins with a digit or contains a space, the name must be in quotes e.g. **sname** *Vaisala MAWS*.
spclear	spclear <*parameter/ALL*> clears a static parameter/all parameters.NOTE! This command clears QMS101 and QMN101 sensitivity settings and is not usually needed.
spset	spset [*parameter*] [*value*] sets a value to a static parameter. To see a list of static parameters, type **spset**. NOTE! This command is not usually needed.
SYSINFO	SYSINFO gives information on the system. NOTE! The command must be written in upper case.
time	time [*HH MM SS YY MM DD*]. To see the current time, type **time**. To change the current time, type time and the new time. E.g. **time** *14 10 00*. To change the current date, type time and the new time and date e.g. **time** *14 10 00 98 12 31*.
timezone	timezone [*hours*] sets the time difference from UTC. To see the time zone, type **timezone**. To set the time zone, type e.g. **timezone** *2*.

Table 18 Command Set (Continued)

Command	Description
userlevel	userlevel [*level* <*set/clear*>] command is used to protect system from unauthorized use. It provides three password protected access levels to shell commands as well as to the visibility of system data. By default, the user levels are not in use.
verify	verify <*source file*> <*destination file*> compares two files, if they are different response is: `Error: Files are different`
warnings	warnings [*clear*]. To see active warnings, type **warnings**. To clear active warnings, type **warnings** *clear*. Warnings indicate that there are some problems in the software. See Chapter 5, Troubleshooting, on page 165 for more information.
winddircal0	winddircal0 [*direction*]. Set the direction in degrees to align the wind vane. Type for example **winddircal0** *360* (north).
zr	Zmodem receive command is needed when transferring the setup file to MAWS.
zs	zs <*file_name*>. Sends a file from MAWS using Zmodem protocol (used instead of MAWS Terminal function).

NOTE The following commands allow the use of wild cards: **chmod**, **dir**, **del**, **copy**, **move**, **verify**, and **zs**.

Example:

```
copy /log/L2*.* /Ext/log_L2copy
```

NOTE File commands (**dir**, **del**, **copy**, **move**, and **verify**) can be aborted by typing CTRL+C.

CHAPTER 4

MAINTENANCE

This chapter provides information that is needed in the basic maintenance of MAWS, sensors, and accessories.

Routine Maintenance and Calibration

The purpose of periodic maintenance is to keep sensors operational and safe, measurements reliable, to define if any calibration actions are needed, and to extend the lifetime of the system.

Under normal conditions, the MAWS system needs only a minimum amount of maintenance. The need for maintenance depends on the sensors that are connected to your MAWS system.

CAUTION	Do not open the MAWS logger housing under poor conditions, for example, rain or dust in the air. In general, it is not advisable to repair sensors in the field.

Periodic routine maintenance tasks include checking, cleaning, and servicing all the system elements and repairing or replacing the damaged or worn-out components.

The maintenance task should be accomplished only by a technician properly trained for these tasks. The technician must be familiar with the system and know how each component of the system performs. In addition, adequate tools and test equipment have to be at hand to complete the maintenance tasks successfully.

When using high quality sensors and system, most of the routine maintenance tasks can be performed at the installation site. Some instruments and advanced calibrations and refurbishments, require the sensor be returned to the laboratory for proper calibration. When system components need to be brought in from the field, the best procedure is to maintain an inventory of spare components. The user can then exchange a component with a calibrated component or sensor during a single visit. This is the case especially with sensors that must be returned to the manufacturer for calibration.

Before the maintenance actions, certain preparations must be made in order to make the work successful:

- Obtain information on how the site has been functioning before the scheduled maintenance.
- Obtain information on what maintenance tasks were completed during the previous maintenance procedure.
- Make sure that you have all the necessary tools available. The required set of tools depends on the system configuration, however the minimum is listed below:
- A laptop PC with multiple fully charged batteries.
- The latest operational versions of the MAWS operating software version, MAWS Lizard Setup Software, and MAWS Terminal software.
- The configuration file which is used at that particular station to be maintained.
- All the necessary system documentation.
- MAWS Terminal cable (QMZ101).
- Hand held tools; screw drivers, wrenches, pliers, wire cutters, and insulation strippers.
- Digital multimeter.
- Clean cloth, cleaning solution, and cleaning brush.
- Lubricant.
- Anti-seize compound.
- Safety harness, if tower climbing is required.
- All the necessary parts to be changed regularly.
- Make a list of all the sensors requiring replacement with refurbished and calibrated units.

Overall Checking

- Check signal and main cables, connectors, and connections.
- Check gaskets of the enclosures.
- Check all grounding cables, lugs, etc.
- Check mechanical assemblies, bolts, nuts, etc.
- Check for corrosion. Repair if needed.

NOTE	Use the correct tools of good quality.

Cable Maintenance

Inspect cables for breaks, cracks in the protective coating or cable connectors, and bent, damaged, or misaligned pins. Also wipe off or remove excess dirt, dust, sand, or leaves.

Updating Software to the Logger

In order to be able to utilize new features published by Vaisala, you may need to update the logger software.

NOTE	Update the logger software only when requested by Vaisala.

To update the software to the logger:

1. Check that you have the loader program **loader.exe** and the MAWS software **bin.mot** on your computer in the same folder.
2. By default the **loader.exe** application uses the **COM1** port of the computer. When you can use the **COM1** port, proceed with step a. below, otherwise proceed as instructed in step b.

NOTE	If any other COM port of the computer than **COM1** is used for loading the software to MAWS, you need to make a .bat file for software loading. Refer to step b. below.

a. Connect the maintenance terminal cable to the port **COM0** of the MAWS system and to the **COM1** port on your computer.

b. Connect the maintenance terminal cable to the port **COM0** of the MAWS system and to any free COM port on your computer. For example, if the free COM port is **COM3**, make the .bat file with Notepad, see Figure 107 on page 130.

   In the .bat file, the parameter *-s115200* indicates the bit rate (default is 38400) and the parameter *-pCOM3* indicates the communication port (default is **COM1**).

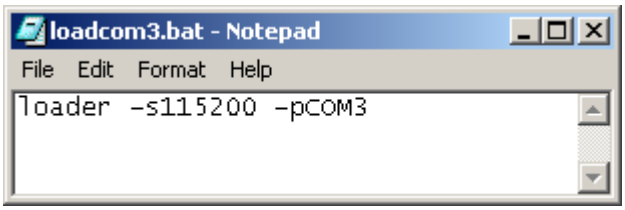


Figure 107 Making the .bat File in Notepad

3. Close any terminal connection to MAWS so that the serial port is free for software loading.
4. Close all other Windows programs.
5. To load the software:

   a. When you are using the **COM1** port of your computer, open Command Prompt and change the directory to the folder where you have **loader.exe** and **bin.mot**. Type **loader** and press ENTER. **Command Prompt** window shows `Waiting`.

   b. When you are using some other communication port, execute the .bat file created in step 2.b. **Command Prompt** window shows `Waiting`.

6. Reset the logger by pressing the reset button.
7. **Command Prompt** window shows `Erasing` for some time and then starts to show `Loading`. If you get a load error, try again from step 2.
8. After a few minutes, display shows `Loading 100 %`.
9. The program restarts with an existing setup and MAWS is now ready to operate. If you give the long reset to MAWS, it starts the program with a blank setup.

If you are having problems when loading software to the logger, for example, loading is interrupted and you get the message `Load Error -1`, try again with all other Windows programs closed, except Command Prompt.

Loading may be interrupted due to a corrupted **bin.mot** file, or due to powersave features, especially when a laptop computer is used.

Spare Parts

Available Spare Parts

Table 19 Available Spare Parts

Spare part name	For...	Order code
Cup wheel assembly	WMS302	WA45233
Anemometer bearing assembly	WMS302	WA45232
Vane assembly	WMS302	WA35234
Vane bearings assembly	WMS302	WA45247
Humidity sensor	HMP45D	HUMICAP®180
Temperature sensor Pt-100 IEC 751 1/3 Class B (HMP45D)	HMP45D	19159
Membrane filter (standard)	HMP45D	2787HM
HMP45D probe head	HMP45D	HMP45DSP

Ordering Spare Parts

Contact your local Vaisala representative for a complete list of spare parts and for ordering spare parts or optional units.

Solar Panel

Periodic Maintenance

WARNING	Wear rubber gloves to protect yourself against possible electric shock.

CAUTION	Do not use a scrub brush; it can damage the module front surface.

Inspect the module at least twice a year for overall integrity. Make sure that connections to the battery are tight and free of corrosion.

Dirt accumulation on the module's front surface can reduce the light energy collected by the module. If the module surface is dirty, gently clean it with a soft cloth or sponge using water and a mild detergent.

Ultrasonic Wind Sensor

Periodic Maintenance

The accuracy of the sensor depends on the accuracy of two factors:

1. The distance between the ultrasonic transmitter and receiver. This requires a measurement of the transducer arm trueness.
2. The time-of-flight measurement circuit, which uses a crystal oscillator for its time reference.

NOTE	The crystal oscillator is used by the communications circuit for the bit rate generator. If you use the serial communication modes and the oscillator loses accuracy, the sensor stops communicating. Thus, the sensor cannot send erroneous values produced by faulty timing.

If you use the RS-232 operational modes, conduct periodic testing to detect slow deterioration of the sensor before it significantly affects accuracy. Perform the test either in the field or in a laboratory. The periodic test uses the margin verifier, which is a small echo-free

chamber with built-in 10 dB sonic attenuators in each of the three sonic paths. The margin verifier is shown in Figure 108 on page 134.

This test verifies the following:

- Transducer arm trueness, since the verifier can not be put into place if an arm is bent
- Transmitter output power
- Transmitter and receiver transducer efficiency
- Receiver sensitivity
- Acoustic crosstalk from any transmitter to any receiver
- Electric crosstalk
- Automatic gain threshold detectors.

This test demonstrates that the sensor will work at high wind speeds since the signal-to-noise ratio decreases as wind speed increases. As wind speed increases, turbulence increases acoustic noise. At the same time, acoustic lenses that form around the transducers (because of air pressure gradients) reduce the received signal.

Since the margin verifier decreases the signal-to-noise ratio to a level that is slightly lower than it would be with the highest allowed wind speed by the sensor, a zero wind speed reading with the verifier in place indicates accurate readings at high wind speeds.

The test consists of the following steps:

1. Slip the margin verifier over the three transducers (see Figure 108 on page 134).
2. In outdoor conditions, secure the zero wind flow by covering the sensor and margin verifier.
3. The sensor must read less than 0.5 miles per hour (0.22 m/s) with the margin verifier in place.

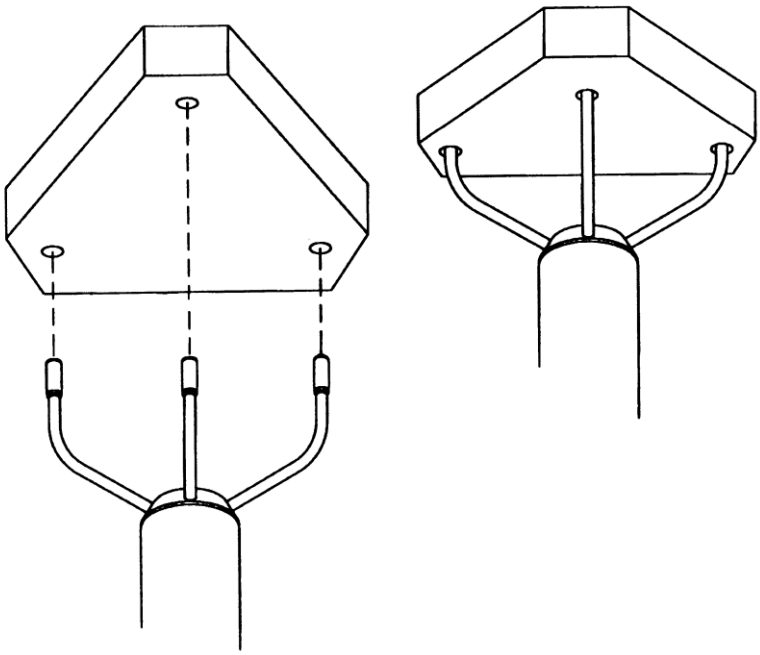


Figure 108 Margin Verifier

NOTE	Some random data samples may be lost during the zero verifier test. This, however, does not indicate that the sensor is faulty.

Combined Wind Sensor

Periodic Maintenance

Testing Proper Operation

It is recommended to check the ball bearings of the anemometer and the vane every year. If the cup wheel or the vane is not rotating smoothly or it creates detectable noise, the bearings must be replaced.

Replacing Consumables

Only a trained technician should replace the bearings.

If your sensor includes the alignment sleeve and the factory alignment has not been altered, you can simply remove and remount the sensor to its place with the plastic collar without realigning.

To replace the ball bearings, do the following (the numbers refer to Figure 109 on page 136):

Anemometer bearings:

1. Loosen the hubnut (14) with fingers or a 10 mm tool and remove the cup wheel (13).
2. Remove the ball bearing assembly (12) by unscrewing it counterclockwise (with a 10 mm tool).
3. Insert a new bearing assembly (12). Tighten gently.
4. Fasten the cup wheel to the sensor. Tighten gently.

Vane bearings:

1. Proceed as described in steps 1 and 2 above.
2. Open the lock screw (11) of the tail assembly (10) and remove the screw.
3. Remove the Seeger-ring (9) (with narrow point pliers).
4. Remove the bearing assembly (8).
5. Replace the bearings inside the housing with new ones.
6. Assemble the sensor in the reverse work order.

Note that part number 6 in Figure 109 on page 136 consists of two parts. The lower portion has a notch that is aligned at the factory in relation to the output of the potentiometer to point north when the sensor is mounted.

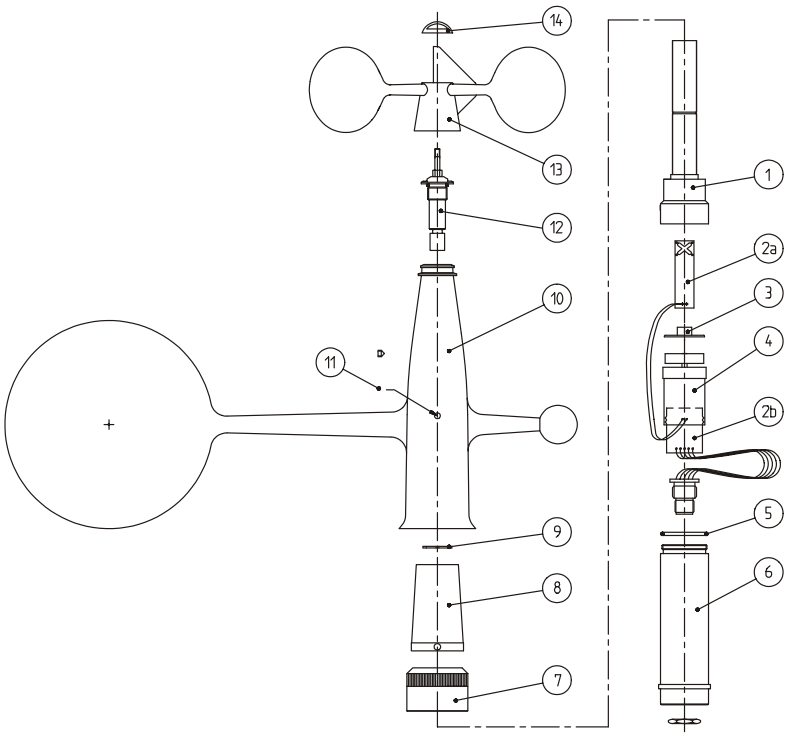


Figure 109 WMS Assembly

The following numbers refer to Figure 109 on page 136:

1 = Casing
2a = Reed switch PCB
2b = Potentiometer PCB
3 = Retainer
4 = Sleeve
5 = O-ring
6 = Base part
7 = Mast adapter sleeve
8 = Bearing assembly
9 = Seeger ring
10 = Tail assembly
11 = Lock screw
12 = Bearing assembly
13 = Cup wheel
14 = Hubnut

Anemometers

Periodic Maintenance

Cleaning

Heavy contamination in the cups, such as bird dropplets or ice will deteriorate the accuracy of the anemometer. Clean the cups when necessary.

Testing Proper Operation

The sensor will hold its accuracy in all conditions for 1 year. If the rains are mostly casual and moderate, and the atmospheric corrosion is typical, the sensor accuracy will remain for 2 years.

However, the ball bearings must be checked once a year and the sensor shaft rotated manually. To do this, remove the cup wheel. To ensure proper operation, the shaft should spin smoothly and it should not create any detectable noises.

Replacing Bearings of WAA151

Replacement of the ball bearings should only be done by a trained technician. To replace the ball bearings of WAA151, follow the procedure below and refer to Figure 110 on page 140.

1. Open the cup wheel fixing screw with a 2-mm Allen key. Remove the cup wheel assembly.

CAUTION	The cup wheel fixing screw has been treated with sealant. Do not remove the fixing screw to ensure perfect sealing after reassembling.

2. Loosen the hex nut of the connector with a 22-mm tool.

CAUTION	Be careful not to bend the connector pins.

3. Loosen the three pan head screws at the bottom of the sensor body with a 7-mm tool.

4. Remove the lower body assembly by pulling it straight outwards.
5. Loosen the spacer screws with a 7-mm tool and disconnect the heating element outlet.
6. Remove the printed circuit board including the opto-coupler.

CAUTION	Do not twist or bend the connector. This may break the pins.

7. Loosen the fixing screw of the chopper disc with a 2-mm Allen key and remove the chopper disc.
8. Remove the external retaining ring (using narrow-pointed pliers).
9. Remove the spacer ring.
10. Remove the internal retaining ring at the bottom of the shaft (using narrow-pointed pliers).
11. Remove the lower bearing.
12. Push out the shaft downwards through the upper body.
13. Remove the top bearing after pulling out the shaft.

To reassemble the sensor, reverse the above work order . The numbers in parenthesis refer to Figure 110 on page 140.

1. Take the previous steps in opposite order until assembling the chopper disc.

NOTE	Be careful when handling the new ball bearings. Do not drop them or force them onto the shaft.

2. Attach the chopper disc (7) back onto the shaft. The disc has to be positioned so that the disc teeth do not touch the opto-coupler (6) on the circuit board. Tighten the screw.

CAUTION	Assure that the chopper disc teeth do not touch the opto-coupler. There should be from 1 to 2 mm space between the bottom of the opto-coupler and the disc teeth.

3. Attach the heating element outlet (5) to the circuit board. Put the circuit board in place and fasten it with spacers (5).
4. Put the lower body assembly (4) carefully into place. Fasten the three screws (3) at the bottom of the sensor. Make sure that the bigger O-ring (14) is correctly positioned between the upper and

the lower sensor bodies. The O-ring is recommended to be replaced with a new one after each opening. Check also that the connector's O-ring (14) is properly in its place.

NOTE When placing the lower body assembly, make sure that the O-ring is correctly positioned between the upper and lower bodies. It is recommended to replace the O-rings with a new ones before reassembling.

5. Tighten the hexagon nut of the connector (2).
6. Connect the cable plug to the sensor body connector. Fasten the sensor body on the crossarm with three screws.
7. Mount the cup assembly onto the sensor body. Tighten the fixing screw.

The following numbers refer to Figure 110 on page 140:

1 = Cup wheel assembly
2 = Hex nut of the connector
3 = M6x16 DIN7991 (3 pcs)
4 = Lower body
5 = Spacer (3 pcs)
6 = Printed circuit board (PCB)
7 = Chopper disc
8 = External retaining ring, body
9 = Spacer ring
10 = Internal retaining ring, shaft
11 = Ball bearings
12 = Shaft and Upper body assembly
13 = Ball bearings
14 = O-rings, 2 pcs

CAUTION The heating resistance element cannot be removed without special tools. To avoid any damages, it is recommended that replacement of the heating element be carried out by the manufacturer.

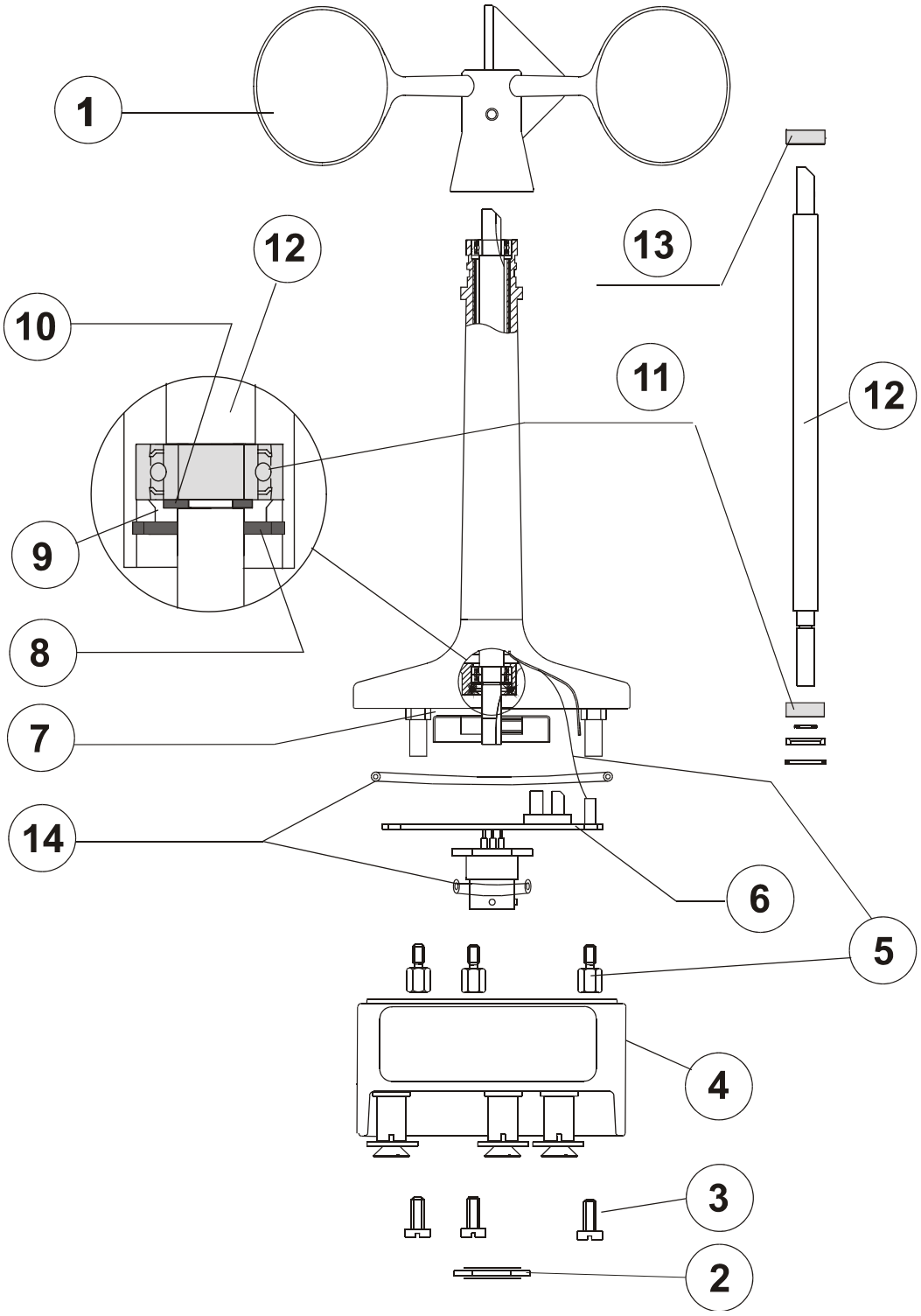


Figure 110 WAA151 Assembly

Replacing Bearings of WAA252

Replacement of the bearings should be done only by a trained technician. First steps from 1 to 14 are for disassembling and second steps from 1 to 11 are for reassembling. The numbers in parenthesis refer to Figure 111 on page 143. To replace the ball bearings of WAA252, follow the procedure below:

1. Loosen the set screw (with an Allen key) and carefully remove the cup assembly.

CAUTION Be careful not to bend the connector pins.

2. Loosen the hex nut of the green MIL-connector at the bottom of the sensor body with a 22-mm tool.
3. Loosen the three capnuts (1) at the bottom of the sensor body with a 7-mm tool.
4. Remove the body cover and the O-rings (2).
5. Release the connector (3) of two white wires from the power supply board (4).
6. Loosen the three nuts (5) at the bottom of the power supply board (4) and remove it with a 7-mm tool).
7. Loosen the shaft heating foil (6) (use pliers).
8. Loosen the set screw of the rotating transformer assembly (7) (use an Allen key).
9. Loosen the spacer screws (8) with a 6-mm tool.
10. Remove the sensor board (9) together with the rotating transformer assembly (7).

CAUTION Handle the rotating transformer carefully, do not drop or hit.

11. Remove the retaining ring (10) (use narrow-pointed pliers) and the bushing (11) from the shaft tunnel.
12. Remove the upper bearing (12) after pulling out the shaft.

CAUTION Handle the shaft carefully, do not drop or hit.

13. Remove the retaining ring (13) at the shaft.

14. Remove the lower bearing (14).

For reassembling the sensor:

1. Install the bearings in reverse order.

NOTE	Be careful when assembling the bearings, do not drop or hit.

2. The rotating transformer assembly (7) is reinstalled together with the sensor board (9). Its (7) set screw is not fastened until in step 7, when the power supply board has been reinstalled and the gap adjusted.
3. When assembling, push the transformer (7) as far up as possible towards the shaft tunnel.
4. Reassemble the spacer screws (8), the power supply board (4), and tighten the nuts (5).

NOTE	Make sure that the four-pin connector (15) fits properly.

5. For adjusting the gap, place a 0.4 mm (0.016 in.) feeler gauge between ferrite coils (parts 4 and 7) (preferably use a 30 mm wide feeler gauge).
6. Place a screwdriver tip into the slot between the top end of rotating transformer assembly (7) and the shaft tunnel, and pry until the air gap between ferrite coils is 0.4 mm (0.016 in.) (use the feeler gauge for measuring).

CAUTION	The ferrite coils are breakable, do not try to adjust the gap by prising them.

7. When the gap is right, carefully fasten the set screw of the rotating transformer assembly (7).

CAUTION	Make sure the rotating transformer assembly rotates freely without touching the lower part at any rotary position of the shaft.

8. Reconnect the shaft heating foil (6) and the connector for the two white wires (3).
9. Reassemble the body cover (2) with new O-rings.
10. Tighten the three capnuts (1) and the connector nut.

11. Install the cup assembly. Align the planes in the shaft and inside the hub. The bottom edges of the hub and the shoulder should reach approximately the same level. Tighten the fixing screw.

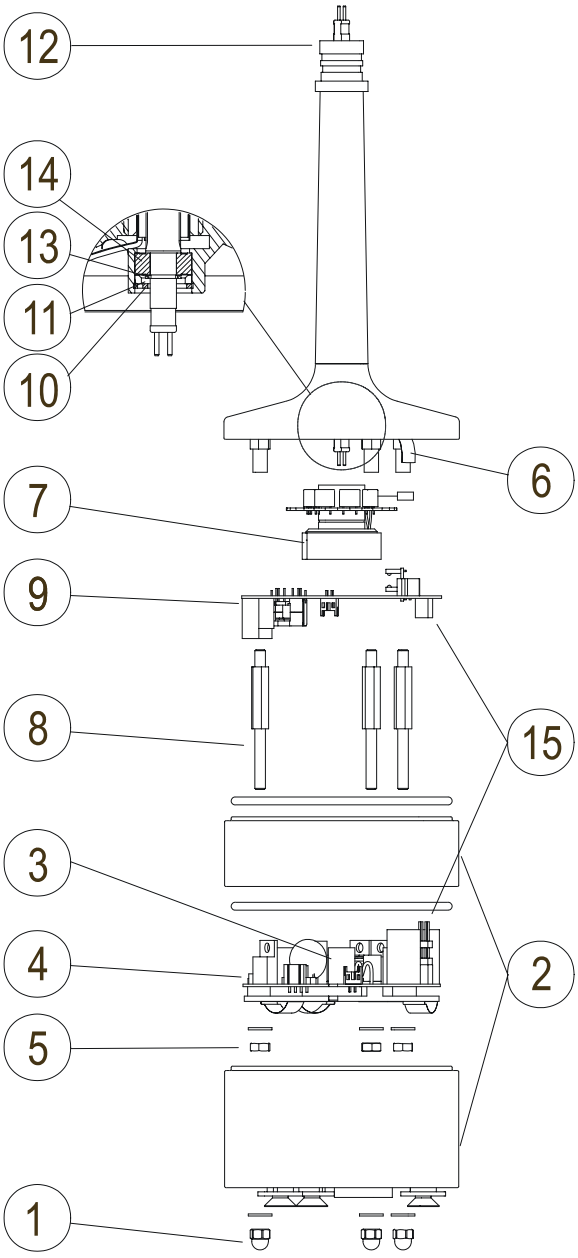


Figure 111 WAA252 Assembly

CAUTION	The heating resistance element cannot be removed without special tools. To avoid any damages, it is recommended that replacement of the heating element be carried out by the manufacturer.

Wind Vanes

Periodic Maintenance

Cleaning

Heavy contamination in the vane, such as bird dropplets or ice will deteriorate the accuracy of the wind vane. Clean the vane when necessary.

Testing Proper Operation

The sensor will hold its accuracy in all conditions for 1 year. If the rains are mostly casual and moderate, and the atmospheric corrosion is typical, the sensor accuracy will remain for 2 years.

However, the ball bearings must be checked once a year and the sensor shaft rotated manually. To do this, remove the vane assembly. To ensure proper operation, the shaft should spin smoothly and it should not create any detectable noises.

Replacing Bearings of WAV151

Replacement of the bearings should only be done by a trained technician. To replace the ball bearings of WAV151, follow the procedure below and refer to Figure 112 on page 147.

1. Open the vane assembly fixing screw with a 2-mm Allen key. The correct screw is the lower one shown in Figure 112 on page 147. Remove the vane assembly.

CAUTION	The vane assembly fixing screw has been treated with sealant. Do not remove the fixing screw to ensure perfect sealing after reassembling.

2. Loosen the hex nut of the connector with a 27-mm tool.

CAUTION Be careful not to bend the connector pins.

3. Loosen the three pan head screws at the bottom of the sensor body with a 7-mm tool.
4. Remove the lower body assembly by pulling it straight outwards.
5. Loosen the spacer screws with a 7-mm tool and disconnect the heating element outlet.
6. Remove the printed circuit board.

CAUTION Do not twist or bend the connector. This may break the pins.

7. Loosen the fixing screw of the code disc with a 2-mm Allen key and remove the disc.
8. Remove the external retaining ring (using narrow-pointed pliers).
9. Remove the spacer ring.
10. Remove the internal retaining ring at the bottom of the shaft (using narrow-pointed pliers).
11. Remove the lower bearing.
12. Push out the shaft downwards through the upper body.
13. Remove the top bearing after pulling out the shaft.

To reassemble the sensor, reverse the above work order. The numbers in parenthesis refer to Figure 112 on page 147.

1. Take the previous steps in opposite order until assembling the code disc.

NOTE Be careful when handling the new ball bearings. Do not drop them or force them onto the shaft.

2. Attach the code disc (7) back onto the shaft. The disc has to be positioned so that it does not touch the opto-coupler on the printed circuit board (6). Tighten the fixing screw of the code disc.

CAUTION Assure that the code disc does not touch the opto-coupler.

3. Attach the heating element outlet to the printed circuit board. Put the printed circuit board in place and fasten it with spacers (5).
4. Put the lower body assembly (4) carefully into place. Fasten the three screws (3) at the bottom of the sensor. Make sure that the bigger O-ring (14) is correctly positioned between the upper and the lower sensor bodies. Check also that the connector O-ring (14) is in place. The O-ring is recommended to be replaced with a new one after each opening.

NOTE When placing the lower body assembly, make sure that the O-ring is correctly positioned between the upper and lower bodies. It is recommended to replace the O-rings with new ones before reassembling.

5. Tighten the hexagon nut of the connector (2).
6. Connect the cable plug to the sensor body connector. Fasten the sensor body on the crossarm with three screws.
7. Mount the vane assembly onto the sensor body. Tighten the fixing screw.

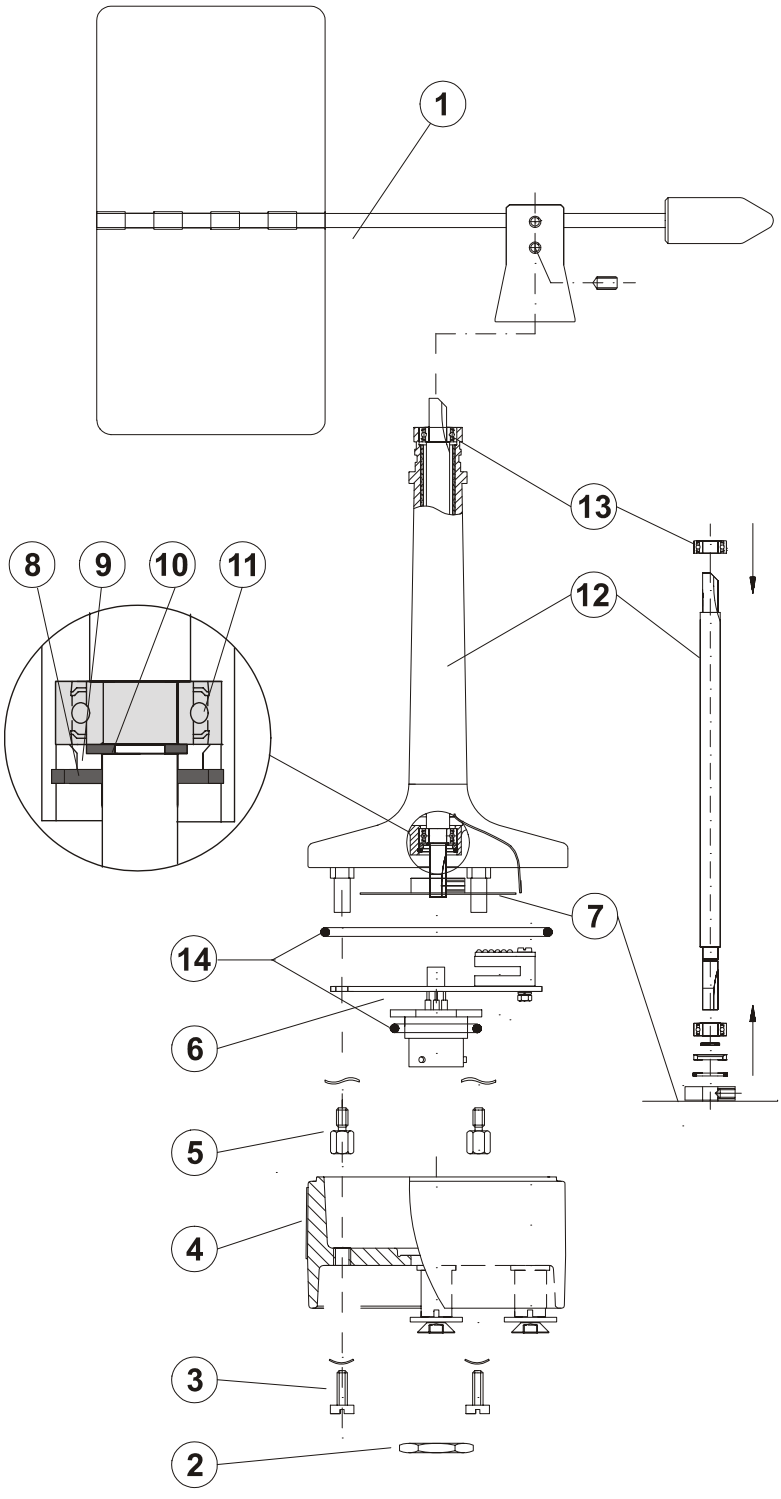


Figure 112 WAV151 Assembly

The following numbers refer to Figure 112 on page 147:

1 = Vane assembly
2 = Hex nut of the connector
3 = M6 x 16 DIN7991 (3 pcs)
4 = Lower body
5 = Spacer (3 pcs)
6 = Printed circuit board (PCB)
7 = Code disc
8 = External retaining ring, body
9 = Spacer ring
10 = Internal retaining ring, shaft
11 = Ball bearings
12 = Shaft and Upper body assembly
13 = Ball bearings
14 = O-rings, 2 pcs

Replacing Bearings of WAV252

Replacement of the bearings should be done only by a trained technician. First steps from 1 to 14 are for disassembling and second steps from 1 to 11 are for reassembling. The numbers in parenthesis refer to Figure 111 on page 143. To replace the ball bearings of WAV252, follow the procedure below:

1. Loosen the set screw (with an Allen key) and carefully remove the vane assembly.

CAUTION Be careful not to bend the connector pins.

2. Loosen the hex nut of the green MIL-connector at the bottom of the sensor body with a 22-mm tool.
3. Loosen the three capnuts (1) at the bottom of the sensor body with a 7-mm tool.
4. Remove the body cover and the O-rings (2).
5. Release the connector (3) of two white wires from the power supply board (4).

6. Loosen the three nuts (5) at the bottom of the power supply board (4) and remove it with a 7-mm tool.
7. Loosen the shaft heating foil (6) (use pliers).
8. Loosen the set screw of the rotating transformer assembly (7) (use an Allen key).
9. Loosen the spacer screws (8) with a 6-mm tool.
10. Remove the sensor board (9) together with the rotating transformer assembly (7).

CAUTION Handle the rotating transformer carefully, do not drop or hit.

11. Remove the retaining ring (10) (use narrow-pointed pliers) and the bushing (11) from the shaft tunnel.
12. Remove the upper bearing (12) after pulling out the shaft.

CAUTION Handle the shaft carefully, do not drop or hit.

13. Remove the retaining ring (13) at the shaft.
14. Remove the lower bearing (14).

For reassembling the sensor:

1. Install the bearings in reverse order.

NOTE Be careful when assembling the bearings, do not drop or hit.

2. The rotating transformer assembly (7) is reinstalled together with the sensor board (9). Its (7) set screw is not fastened until in step 7, when the power supply board has been reinstalled and the gap adjusted.
3. When assembling, push the transformer (7) as far up as possible towards the shaft tunnel.
4. Reassemble the spacer screws (8), the power supply board (4), and tighten the nuts (5).

NOTE Make sure that the four-pin connector (15) fits properly.

5. For adjusting the gap, place a 0.4 mm (0.016 in.) feeler gauge between ferrite coils (parts 4 and 7) (preferably use a 30 mm wide feeler gauge).
6. Place a screwdriver tip into the slot between the top end of rotating transformer assembly (7) and the shaft tunnel, and pry until the air gap between ferrite coils is 0.4 mm (0.016 in.) (use the feeler gauge for measuring).

CAUTION The ferrite coils are breakable, do not try to adjust the gap by prising them.

7. When the gap is right, carefully fasten the set screw of the rotating transformer assembly (7).

CAUTION Make sure the rotating transformer assembly rotates freely without touching the lower part at any rotary position of the shaft.

8. Reconnect the shaft heating foil (6) and the connector for the two white wires (3).
9. Reassemble the body cover (2) with new O-rings.
10. Tighten the three capnuts (1) and the connector nut.
11. Install the vane assembly. Align the planes in the shaft and inside the hub. The bottom edges of the hub and the shoulder should reach approximately the same level. Tighten the fixing screw.

CAUTION The heating resistance element cannot be removed without special tools. To avoid any damages, it is recommended that replacement of the heating element be carried out by the manufacturer.

The wind vane has been counter-balanced at the factory but can be readjusted, if necessary. To do this, loosen the vane assembly and place it on its side on the table. A correctly balanced vane will stay in horizontal position.

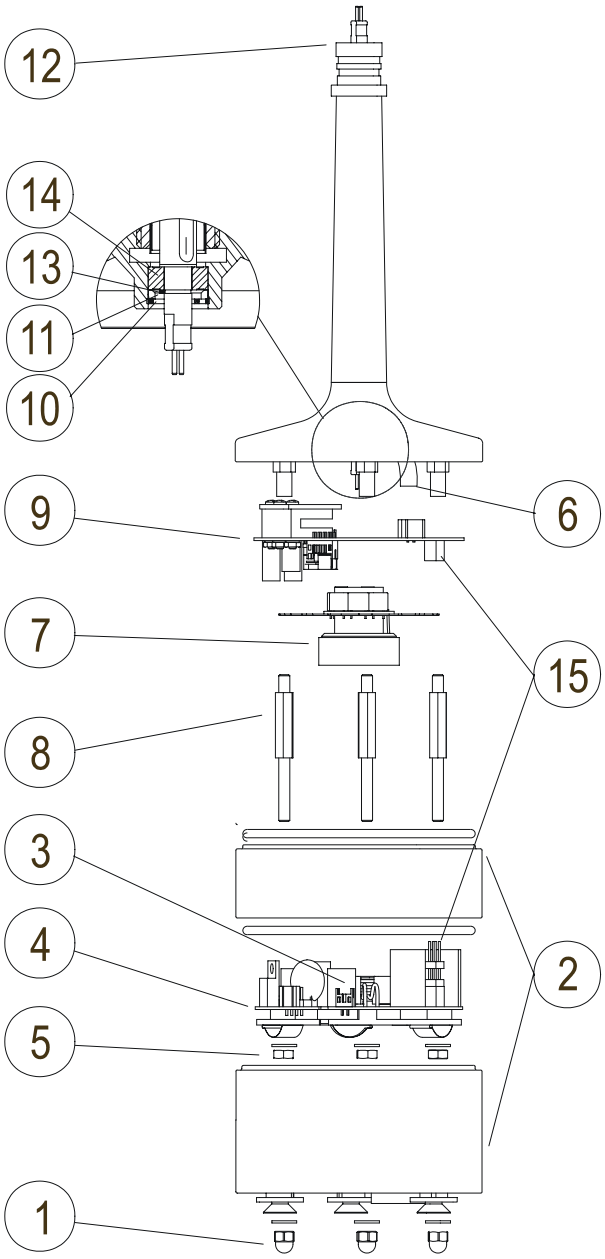


Figure 113 WAV252 Assembly

Wind Transmitter

Periodic Maintenance

When Digital Wind Transmitter WT521 is installed to tropical, marine, or cold temperature environments, it is important to take care that the equipment is kept within specific operating conditions. The cable glands must be properly tightened to avoid dust, dirt, or water to enter into the equipment.

Air Temperature and Relative Humidity Sensor

Periodic Maintenance

Calibration and maintenance of the air temperature and relative humidity probe should be performed at regular intervals, depending on the conditions of use and desired accuracy. The validity of the readings should be checked annually.

The Air Temperature and Relative Humidity probes are easy to maintain and calibrate. The sensor consists of a probe head and a handle with cable. All calibration electronics are in the probe head, which can be disconnected from the handle without disconnecting the wires, as shown in Figure 114 on page 153. If you wish to continue the measurement immediately, you can insert a calibrated probe head in place of the disconnected one; this way the measurement is interrupted for less than a minute.

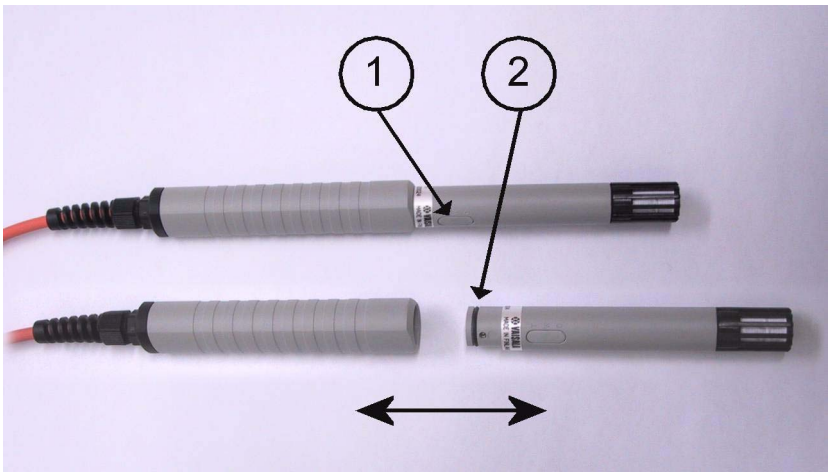


Figure 114 Probe Maintenance

The following numbers refer to Figure 114 on page 153.

1 = Adjustment trimmers: W = wet, D = dry, (T = temperature; for factory use only)

2 = O-ring for sealing the probe weather tight

Changing the HUMICAP®180 Humidity Sensor

Unscrew the filter. Remove the damaged sensor and mount a new HUMICAP®180 humidity sensor in its place. Handle the sensor with care. Calibrate the probe using a two-point calibration procedure.

Humidity Calibration

For a high-accuracy two-point calibration, use a Vaisala HMK15 calibrator and saturated salt solutions. Refer to the appropriate manual for details.

Easiest way of doing the calibration is to use HMI41 Indicator with the HMH40-MAWS Handle for the probe head. Note that this setup is only for relative humidity and no temperature readings are displayed.

Figure 115 HMH40-MAWS Handle

Leave the calibrator and the probe head in the same space for at least four hours so that their temperatures have time to equalize. Unscrew the plastic grid of the probe.

The calibration is done first for the dry end (<50 %RH) and then for the wet end (>50 %RH) by adjusting the trimmer potentiometers marked with **D** (dry) and **W** (wet). The potentiometers are located under a protective plug. Use a ceramic with 2.5 mm (0.1 in.) blade for adjusting the potentiometers.

NOTE If zero point is calibrated in nitrogen (N2), the minimum output signal of 0.008 V corresponds to a relative humidity of 0.8 %RH.

Table 20 Greenspan's Calibration

Temperature [°C]	15	20	25	30	35
LiCl [%RH]	[1]	11.3	11.3	11.3	11.3
NaCl [%RH]	75.6	75.5	75.3	75.1	74.9
K2SO4 [%RH]	97.9	97.6	97.3	97.0	96.7

1. Do not use or store the LiCl solution in temperatures below +18 °C (64 °F) as its humidity equilibrium may change permanently.

As the **D** (dry) and **W** (wet) adjustments may affect each other, recheck the humidity reading at the low end. If necessary, repeat the adjustments in both the low and the high humidity points, until the reading is correct.

Pressure Sensor

Periodic Maintenance

Under normal operating conditions, PMT16A needs only a minimal amount of maintenance.

- Keep the pressure port clean. Check the pressure port every time when visiting the site.
- Annually, compare pressure values against a calibrated portable standard.

Calibration

The MAWS software provides means for one-point field calibration of the PMT16A sensor.

Required equipment:

- Laptop PC with a terminal software
- Travelling standard barometer (for example Vaisala PTB220TS)
- Terminal cable QMZ101 (included in the MAWS delivery).

Calibration procedure:

1. Establish terminal connection to MAWS by connecting the terminal cable to the COM0 port of MAWS and to an available I/O port on your PC.
2. Place both pressure sensors at the same level.

NOTE	Make sure that the wind does not interfere with the reading of the reference barometer.

3. Read the reference barometer reading.
4. Give this reference reading to MAWS.

   Type: **PMT16CAL** *1003.7* (reference reading *1003.7* hPa)

5. Check the readings given by MAWS.

   Value = reference reading

   Measured value = measured by MAWS

   Offset = measured value - reference reading
6. Repeat the calibration if necessary.
7. Close the terminal connection by giving the **close** command.

Rain Gauges

Periodic Maintenance of QMR102

To ensure reliable and accurate measurements, Vaisala recommends that the following checks be carried out at each visit to the rain gauge.

NOTE	If the gauge is connected to the AWS logger and the logger is operating, avoid tipping the cup assembly.

1. Inspect the funnel and filter for any damage or blockage. At certain times of the year leaves may have accumulated in the funnel, dirt and dust can also block the filter preventing or reducing the flow rate to a slow drip into the buckets beneath. The leaves can easily be removed from the funnel and the filter can be cleaned by removing the end cap from the filter tube. Remove the filter material carefully, clean and replace the filter and cap.
2. Check that the gauge is still level. It is surprisingly easy for an apparently immovable gauge to become tilted as a result of small ground movements, vandalism or just an inquisitive finger.
3. Remove and clean any dirt from the bucket.
4. There will be times when the rain gauge will not log or will be disconnected from the logger. In such cases, it is a good idea to check the balance arm of the bucket for stiffness. The easiest way to do this in the field is to try to balance the bucket in its center position. It should be very difficult, if not impossible, to achieve this. If the bucket balances easily then examine the bucket closely for any dirt or wear on the pivot pin and bucket tubes.

Periodic Maintenance of RG13/ RG13H

Periodically check for dirt in the funnel and blockage of the inlet and outlet ports. Remove any dirt and clean the meshes. Unscrew the inlet mesh, and clean it. If necessary, the bucket surface can be cleaned using a mild detergent.

Rain Detector

Periodic Maintenance

CAUTION	Touch grounded metallic parts of the system with your hand before touching the sensor plate of DRD11A. This will discharge possible electrostatic load of your body to avoid damage to the sensor plate.

Clean DRD11A at least once a year or more often in case the sensor surface has become dirty.

- Clean DRD11A carefully with a soft lint-free cloth moistened with mild detergent. Be careful not to scratch the glass surface.
- Check that the detector and the wind shield are free of ice and snow deposits.

Ultrasonic Snow Level Sensor

During a severe storm event, Snow Level Sensor DCU7210 may fail to detect the snow level. After the storm, the sensor will work properly.

Solar Radiation Sensors

Periodoc Maintenance of QMS101/ QMS102

The pyranometer is an all weather instrument. Once installed the pyranometer needs little maintenance. It is recommended that you clean the detector as part of a regular routine, using water or alcohol.

Re-calibration is suggested every two years. This can be done in two ways. The first is to compare with the measurement of a similar sensor at the same site. Daily totals of at least two days should be compared. Calibration factor should be corrected if results differ by more than six per cent. The second way is to let a re-calibration be performed at the factory.

If necessary, the sensitivity of the pyranometer can be adjusted. This can be done by soldering a resistor between the + (white) and - (black) output wires. In this way the pyranometer is shunted. For the standard pyranometer, the internal resistance is 47 Ω, and the cable resistance is 0.12 Ω/m. The cable is 3 m long. The cable resistance has to be multiplied by two, for the + and - wire. Total resistance is 47.7 Ω. In order to reduce the sensitivity by a factor of 10, when the full 3 meters of cable is used, a shunt resistor of 5.3 Ω can be made out of a 1 and a 4.3 Ω resistor. The order of magnitude for the sensitivity will be 10 $\mu V/Wm^{-2}$.

The general formula for establishing the proper resistor for trimming by a factor of 10 is [47 + (0.24 × cable length)]/9. The cable length is in meters and the resistance is in ohms.

Periodic Maintenance of CM Series Sensors

The CM Series sensor is an all weather instrument. Once installed the sensor needs little maintenance. The outer dome must be inspected at regular intervals and cleaned regularly. In some installations, the exposed dome of the pyranometer needs to be ventilated continuously by a blower to keep the dome above dew point temperature.

When the blue silicagel in the drying cartridge is turned completely pink (normally after several months), it must be replaced by active material. Pink silicagel can be activated again in an oven at 130 °C.

Because the sensitivity changes with time and exposure to radiation, re-calibration is suggested at least every two years at the factory.

Net Radiometer

Periodic Maintenance

The Net Radiometer CNR1 is an all-weather instrument.Once installed it needs little maintenance. It is suggested that one clean the windows and domes as part of a regular routine, using water or alcohol.

For quality assurance of the measurement data, we recommend the recalibration of the CNR 1 as part of a regular maintenance schedule. Recalibration is suggested every two years.

Net Solar Radiation Sensor

Periodic Maintenance

The Net Radiation Sensor is an all weather instrument. Once installed it needs little maintenance. It is recommended that you clean the detector as part of a regular routine, using water or alcohol.

Soil/Water Temperature Sensors

Periodic Maintenance

The QMT103/QMT110 sensor does not need any regular maintenance. Field repairs are accomplished by replacing the complete sensor.

When the QMT107 sensor is extracted, clean the dirt accumulation on the sensor surface with a soft cloth or sponge using water and mild detergent. Field repairs are accomplished by replacing the complete sensor.

Soil Moisture Sensor

Periodic Maintenance

The ML2x sensor is sealed after the factory calibration. It does not require any routine maintenance and it is constructed of materials selected for robust field operation. If the measurement rods become bent in use, they can be carefully unscrewed from the body and straightened. They have a right-handed thread. Pay careful attention to the following points:

- Do not remove the cross-head sealing screws. This may damage the seal and will void the warranty. No internal maintenance or repair shall be performed by the user.
- Do not remove the sensor from soil by pulling on the cable.
- Do not attempt to straighten the measurement rods while they are still attached to the probe body. This may break the rods or damage the case seal.

Soil Moisture Sensor

Periodic Maintenance

The ECH_2O-M3 sensor is sealed after the factory calibration. It does not require any routine maintenance and it is constructed of materials selected for robust field operation.

Leaf Wetness Sensor

Periodic Maintenance

Leaf Wetness Sensor does not need any regular maintenance. Field repairs are accomplished by replacing the complete sensor.

Fuel Moisture/Fuel Temperature Sensor

Periodic Maintenance

The sensing element of the sensor is a wooden dowel that exchanges moisture with its surroundings. In the course of a year, it undergoes many cycles of soaking up moisture and drying. These processes eventually cause the structure of the wood to deteriorate. Similarly, dust and other contaminants become embedded in the surface and they change the surface properties. When this occurs, the calibration is no longer valid.

The only way to restore the sensor accuracy is to replace the wooden dowel, which must be done at the factory.

Your experience will eventually determine how frequently the sensor needs service. At the beginning, the manufacturer recommends that you return it to the factory once per year for replacement of the dowel and calibration.

At most sites, where the sensor is used to assess fire danger, there is a season when the danger is low. That is usually a good time to replace or refurbish the sensor.

Present Weather Detector

Periodic Maintenance

Present Weather Detector is designed to operate continuously for several years without other maintenance than cleaning lenses and DRD sensing surface (see Figure 116 on page 162). No initial calibration is

needed, because the sensor has been calibrated at the factory. Periodic maintenance of the Present Weather Detector includes:

- Cleaning of the transmitter and receiver lenses and hoods
- Cleaning of the DRD Rain Detector.

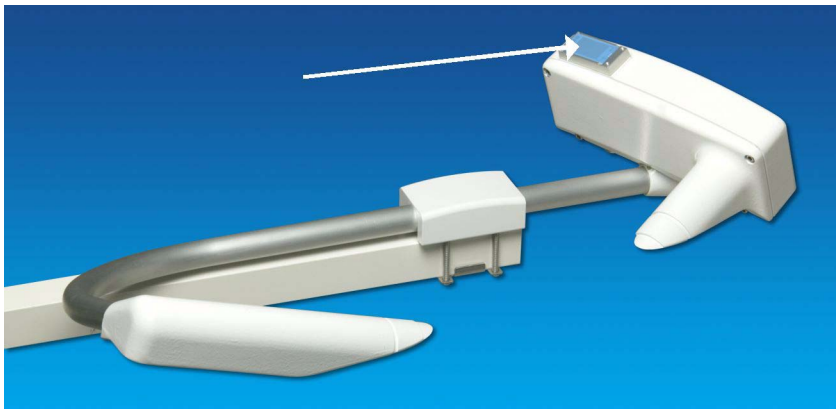


Figure 116 DRD on Present Weather Detector

NOTE	Some erroneous data may be generated due to cleaning the sensor.

Cleaning Lenses and Hoods

The lenses of the transmitter and receiver units should be relatively clean to get reliable results. With dirty lenses, the given visibility values are not reliable. Cleaning should be done every six months or more often depending on the conditions (for example, if there are roads nearby).

1. Clean the lenses with a lens-cleaning wipe. Be careful not to scratch the lens surfaces. Lenses should dry up indicating that the lens heating is functioning.
2. Check that the hoods and lenses are free of condensed water or ice and snow deposits.
3. Wipe the dust from the inner and outer surfaces of the hoods.

Cleaning DRD Rain Detector

The capacitive rain detector DRD should be cleaned every six months or more often depending on the conditions.

CAUTION	The measuring principle does not allow for proper ESD protection of the DRD electronics, therefore you must follow the instructions carefully.

1. Ground your hand by touching grounded metallic parts of the installation to remove excessive static charges from your body.
2. Clean the DRD rain detector carefully with a soft, lint-free cloth moistened with mild detergent. Be careful not to scratch the surface.
3. Check that the detector is free of ice and snow deposits.

For more information, refer to Present Weather Detector User's Guide.

Ceilometer

CAUTION	In the long run, particles between the towel and the window will damage the anti-reflection coating. Therefore, instead of circular rubbing, the window should be wiped once across the window. If additional wiping is needed, a clean part of the towel should be used.

Periodic maintenance is normally limited to window cleaning. In addition, alarms should be checked regularly.

For more information, see Ceilometer CT25K User's Guide.

Present Weather Sensor

Periodic Maintenance

No initial calibration of FD12P is needed, because the sensor has been calibrated at the factory. Periodic maintenance of FD12P Present Weather Sensor includes:

- Cleaning of the transmitter and receiver lenses and hoods
- Cleaning of the DRD12 Rain Detector
- Visibility calibration check, and calibration if needed.
- Calibration of the DTS14 Temperature Sensor.

For more information, refer to FD12P User's Guide.

CHAPTER 5
TROUBLESHOOTING

This section consists of some common MAWS problems, their probable causes, and remedies.

Basic Procedure for Troubleshooting

When troubleshooting the MAWS system, write a problem report consisting the following issues:

- What failed (what worked / did not work)?
- Where did it fail (location and environment)?
- When did it fail (date, immediately / after a while / periodically / randomly)?
- How many failed (only one defect / other same or similar defects / several failures in one unit)?
- What was connected to the product and to which connectors?
- Input power source type, voltage and list of other items (lighting, heaters, motors etc.) that were connected to the same power output.
- What was done when the failure was noticed?

When troubleshooting the MAWS system, make sure you have the tools listed in Table 21 on page 166 available.

Table 21 Recommended Tools for Troubleshooting

Tools List
The terminal cable (QMZ101) and a laptop computer with the applicable versions of the setup files and the MAWS Terminal software
The keys for the enclosures
Multimeter
Flat-blade screwdrivers; especially small ones
Phillips screwdrivers, especially small ones
Set of open-end wrenches, different sizes
Set of Allen keys
Applicable spare parts, e.g., a new logger
Safety helmet when tilting the mast

Follow the procedure below to troubleshoot the MAWS system. Refer to the applicable sections of this chapter for details when requested. The basic procedure for troubleshooting assumes that the person has operating experience of the MAWS system.

1. Check visually the cabling and mechanical structure for indications of vandalism, dirt, lightning strike damage, or other visible cause for the problem. Also check that all the connectors are properly attached. For visual check of the enclosure and the logger, refer to section Visual Check on page 170.
2. The MAWS system appears to be completely down.
   a. Is the green led on the QML201 logger blinking? Refer to section Determining MAWS Operation Mode on page 172. If not check:
      - Is there sufficient voltage (8 ... 16 VDC) present in the EXT-DC input of the logger?
      - Is there internal battery present? If there is, check it's voltage. Completely discharged or otherwise damaged battery can prevent the logger from operating. Refer also to section Battery Status on page 187.

   b. The logger has power but it is not functioning.
      - Connect the terminal cable and start the MAWS Terminal software. To start the terminal connection, refer to section Establishing Terminal Connection on page 172.

- Open the logger cover and press the reset button. Refer to section Resetting MAWS on page 177. After a few seconds, the terminal should start to display logger startup messages.

c. MAWS is not sending anything (nothing is seen on the screen).

- After MAWS has been without power, for example, when you start it for the first time, check the time and date. The timed operations will not work if the correct time is not set.
- Setup is faulty. Press and keep down the reset button for a few seconds. MAWS will restart and display the text `Using blank configuration`.

d. The logger starts up normally, but sends error messages during startup, for example, `!Erroneous setup file`.

- Reload the setup.
- Set the station parameters.
- Restart the system.

e. After uploading a new setup file, MAWS Terminal displays `Unhandled exception number: 39`.

- Setup might include too many calculations, consider removing some calculations.
- The interval between the statistical calculations is too short, consider executing the calculations less frequently. You might, for example, avoid calculations which are executed more frequently than the results are reported or logged.

f. If there are communication modules present, disconnect the power and replace the modules.

- Replace one module at a time and try to restart the system to find out the damaged one.
- Restart the system.

3. MAWS does not receive commands entered in MAWS Terminal.

a. Check the terminal cable connection and that you have the correct terminal cable (QMZ101) in use.

b. The terminal connection is not open.

Type **open** and press ENTER. Note that the command must be typed exactly right before it can be executed and the command is not echoed on the screen.

c. The port settings are not synchronous.

Synchronize PC COM port and MAWS COM port settings.

4. Has someone made any software or hardware changes to the MAWS system prior to malfunction? If so, could those changes have an effect on the operation? You can capture the content shown in MAWS Terminal, refer to section Recording Terminal Connection Text on page 174.

a. When you have loaded a new setup:

- Make sure you have the original setup and the new setup saved as a .dtg file.
- Reload the original setup and verify that system starts and runs with the original setup.
- Check the new setup once again with MAWS Lizard, reload it, and verify that the system starts and runs.

b. When you have installed new hardware:

- Disconnect the new hardware.
- Reload the original setup and verify that the system starts and runs.
- Check the new setup once again with MAWS Lizard.
- Connect the new hardware.
- Reload the new setup and verify that the system starts and runs.

5. Sensor(s) are not working properly.

a. Are there one or multiple malfunctioning sensors? Multiple simultaneous sensor malfunctions in the same logger often indicate a damaged logger.

b. Check the output of the **warnings** and **errors** commands for indication of the probable cause.

- Connect the terminal cable and start MAWS Terminal. Type commands **warnings** and **errors**. For details, see section Warnings and Errors on page 184.

- Pay also attention to the message related to the excitation voltages. If the damaged sensor is powered by the logger, it may cause an overload.

c. If the malfunctioning sensor is measured by the logger:

- Open the sensor calibration view in MAWS Terminal, see section Determining Sensor Status on page 177.
- Check the sensor status and compare the value against the sensor status list in Table 27 on page 180.

d. If the malfunctioning sensor is a so called intelligent sensor, for example, Vaisala Ceilometer or Vaisala Present Weather Detector, use it's own diagnostic features.

- Connect terminal cable and start MAWS Terminal.
- Service interface for the intelligent sensors can be accessed through MAWS as explained in section Opening Service Connection Through MAWS on page 174.

6. Communication is not working properly.

a. Whenever possible use an external device to verify that the communication infrastructure is working properly. For example, use a cellular phone to verify that the signal strength in the site is sufficient or that the SIM card in the MAWS system has the access to the network.

b. Troubleshoot the modems as instructed in section GSM Modems.

c. If the communication device supports ASCII commands, such as for example AT commands for modem, this command interface can be accessed as explained in section Opening Service Connection Through MAWS on page 174.

7. Data is not stored to a memory card.

a. Check the status of the memory card. It is indicated by a LED. Table 28 on page 181 describes the different blinking sequences and the card conditions they indicate.

b. Check that the memory card has been formatted with a command **EXTFS** *ERASE* before use. For more information, refer to section Using External Memory Card on page 181.

Still not functioning? Replace the logger and return the damaged one to Vaisala for repair. For the return instructions, refer to section Return Instructions on page 199.

Visual Check

Open the door of the enclosure, and check that all the equipment is present, see Figure 117 on page 170. Check that the logger, power supply, and communication devices are connected properly to the connectors inside the enclosure.

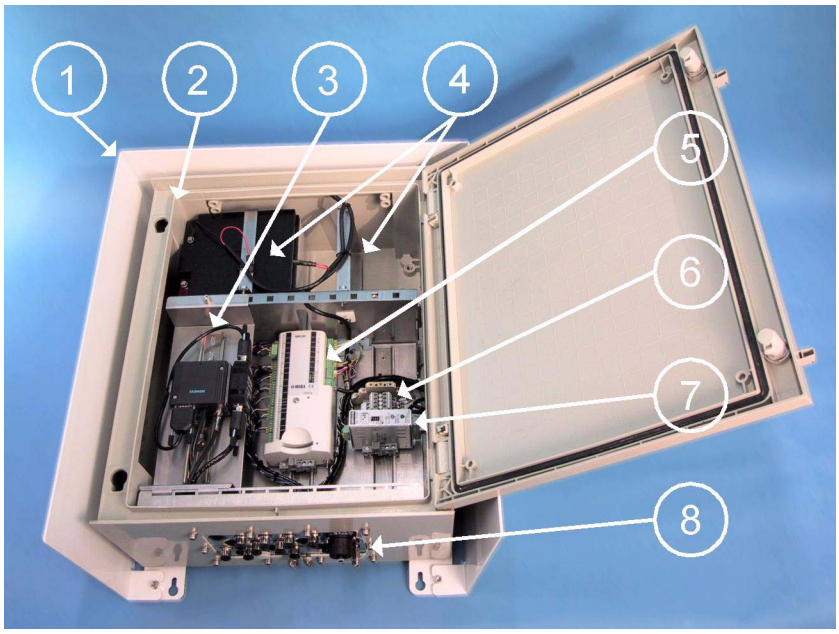


Figure 117 Enclosure ENC542PLM with Radiation Shield

The following numbers refer to Figure 117 on page 170:

1 = Radiation shield
2 = Enclosure
3 = Tiltable plate with DIN-rail
4 = Two places for the batteries
5 = Logger
6 = Terminal strip
7 = Battery regulator
8 = Connector flange

Remove the cover of the logger for checking visually the CPU board and other components located under the cover. In Figure 118 on page 171, the logger is shown without the cover and the optional communication modules.

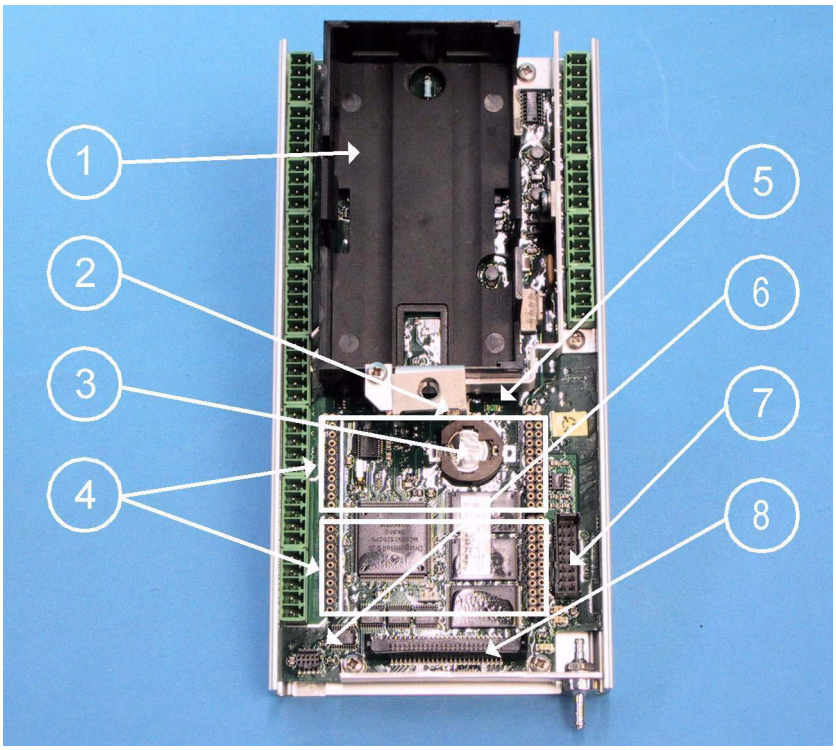


Figure 118 AWS Logger QML201 without Cover

The following numbers refer to Figure 118 on page 171:

1 = Place for the internal battery
2 = Reset button (under the bracket)
3 = Lithium battery for RTC
4 = Communication module places MOD1 and MOD2
5 = Status LED
6 = SPI connector
7 = Pressure sensor connector
8 = CF Card connector

Determining MAWS Operation Mode

You can look at the status LED to determine the MAWS operation mode. The LED is located on the MAWS logger board and it is visible on the logger cover.

Table 22 Determining Operation Mode by LED Flashing

LED Flashing Interval	Operation Mode	Note
All the time	MAWS has been reset but setup has not been examined yet.	
Once per 5 seconds	Setup is running.	
Once per 10 seconds	Blank boot or configuration cannot be run.	
Quickly 2 times	Setup is running but there are warnings.	Interval determined by setup.
Quickly 3 times	Setup is running but there are errors.	
Not at all	None	Check the power supply!

Establishing Terminal Connection

All MAWS software aided troubleshooting is performed using the service terminal connection. Some of the operations can be executed semiautomatically by the MAWS Terminal software, some require entering the commands manually.

To connect your computer to a MAWS serial port, proceed as follows:

1. Connect the provided terminal cable (QMZ101) to the **Maintenance terminal** connector on the bottom flange of the enclosure and to an available COM port on your PC. See Figure 119 on page 173.

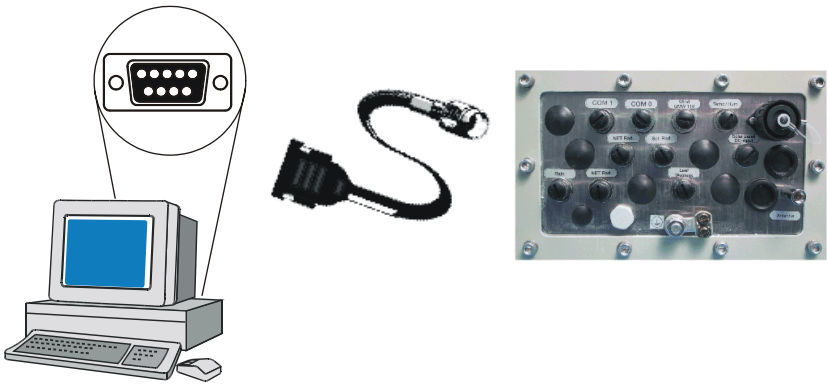


Figure 119 Connecting the Terminal Cable

2. Start the MAWS Terminal program on your PC.
3. Set the communication parameters: 9600, N, 8, 1.
4. Give the command **open** (if the connection is not already open).

NOTE	The command **open** is not echoed on the screen.

Figure 120 on page 173 shows the pin order for the terminal connector.

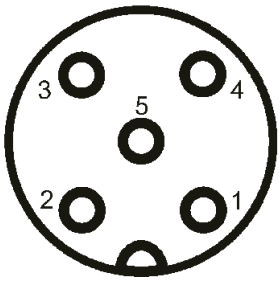


Figure 120 COM0 Pins for the Terminal Connector

The following numbers refer to Figure 120 on page 173.

1 = Not connected
2 = RxD
3 = GND
4 = TxD
5 = Not connected

Recording Terminal Connection Text

In problem situations, you can save the commands and program responses that you see in the MAWS Terminal window. Before you start creating the situation you want to record, clear the terminal buffer. From the **Edit** menu, select **Clear window**. The program removes all text from the terminal buffer.

To capture all the text shown in the MAWS Terminal window into a file, select **Capture all** from the **Connection** menu. The program starts saving all text into a file called *MAWS_Terminal.Log*. This file is stored in the **Default capture text directory** you have defined on the **Directories** tab in the **Preferences** window.

NOTE The **Capture all** selection remains on until you remove the selection from the **Connection** menu. Remember to remove the selection as soon as you have recorded enough messages, otherwise it creates a large file that reserves your disk space.

When you no longer need the capture file, you can delete it from your PC. The capture file is called *MAWS_Terminal.Log* and it is saved in the **Default capture text directory** you have defined on the **Directories** tab in the **Preferences** window.

In the problem situations give the following commands **battery**, **errors**, **spset**, **SYSINFO**, and **warnings**. When the **Capture all** is selected, the results are saved into a file for future use.

Opening Service Connection Through MAWS

The command interface of the modem or an intelligent sensor can be accessed through MAWS, for example, to send the AT commands manually. To control the modem or sensor directly, open the service connection to MAWS, and, for example, when the device is connected to the DSU232's first communication port at the module place **MOD1**, type **open** *DSU232_0_0*. To terminate this operation, type **close**. While the direct connection to the modem or sensor is open, any automatic operation through the connected port is blocked. Typical parameters for the **open** command are presented in Table 23 on page 175. The

information concerning the correct connector can be obtained in MAWS Lizard under **I/O Connections** in the **Equipment** view.

Table 23 Parameters for the Open Command

Connector in MAWS Lizard	Parameter
COM0	COM0
COM1	COM1
DSU232 (MOD1/1)	DSU232_0_0 [1]
DSU232 (MOD1/2)	DSU232_0_1
DSU232 (MOD2/1)	DSU232_1_0
DSU232 (MOD2/2)	DSU232_1_1
DSI486 (MOD1/1)	DSI486_0_0
DSI486 (MOD1/2)	DSI486_0_1 [2]
DSI486 (MOD2/1)	DSI486_1_0
DSI486 (MOD2/2)	DSI486_1_1 [2]

1. With DSU232 and DSI486 modules, the number between underline characters stands for the module place, that is, MOD1 or MOD2, and the last number for the channel on that particular module.
2. With the DSI486 module, the RS-232 connection is possible only to the channel B on the module, that is, the last number is 1.

Connection Problems

If you can not connect to MAWS, the service connection is not opened and you can not work with MAWS. In case of connection problems, check the possible problems as instructed in Table 24 on page 175.

Table 24 Some Common Connection Problems and Their Remedies

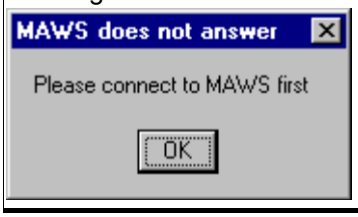
Problem	Probable Cause	Remedy
You receive the following message: 	You are trying to connect to a wrong port.	Select the Address book option from the Settings menu to check the port numbers.
	Cables are not connected.	Check that the modem cable is connected properly.

Table 24 Some Common Connection Problems and Their Remedies (Continued)

Problem	Probable Cause	Remedy
You receive the following message: 	You are trying to connect to a port that does not exist in your computer.	Check the port settings.
	The port is reserved (some other program is connected to it).	It is possible, that you have already opened the MAWS Terminal program, minimized the window and forgotten you have already opened it, and then tried to open the program again.
You do not receive any messages.	Cables are not connected.	Connect the cables as shown in section Establishing Terminal Connection on page 79.

Error Messages

When typing commands, you may encounter some error messages. Table 25 on page 176 explains the most typical error messages.

Table 25 Error Messages

Error Message	Probable Cause	Remedy
Error: Executable not found	Typing error.	Correct typing.
Syntax error!	Typing error: non-acceptable characters, e.g., +	
Error: Directory not found	Typing error in directory name.	
Error: Wrong number of parameters	A missing or extra parameter.	Check the command syntax (**help** *command*) and give the command again.
Error: Missing parameter	A missing parameter.	

Resetting MAWS

To reset MAWS, give the command **reset** (recommended) or press the reset button, see number 1 in Figure 106 on page 122.

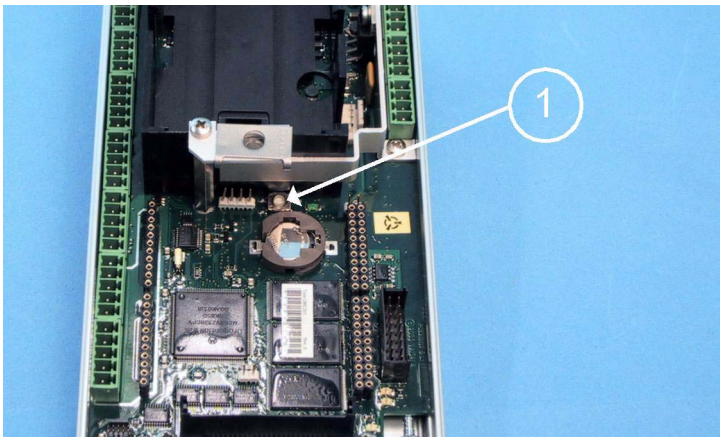


Figure 121 Reset Button on Logger

A short reset (pressing the reset button quickly) performs the same reset as giving the command and starts the program again. A long reset (pressing the reset button and keeping it down for a few seconds) restarts the program with a so-called blank setup. A blank setup does not run a configuration file.

The blank setup may be useful if configuration is somehow defective and does not allow the user to open a terminal connection. When the blank setup is run, MAWS communication parameters are restored to their defaults: COM0, 9600, N, 8, N, 1.

Determining Sensor Status

Sensor status values give indication about the general status of the sensor interfaces. You have two alternatives to view the status value for a sensor:

NOTE	Sensors with their own measurement interfaces and algorithms, for example, Vaisala Ceilometer or Vaisala Present Weather Detector, do not appear in the sensor list of the **Sensor Calibration** tab.

1. For any sensor enter the following service terminal command:

   LASTVAL *<measurement_name> status*

   For example:

   ```
   / > LASTVAL TAMeasQMH101_1 status Status:1 Value:0
   ```

where

Status:1 = The **Status** field in the output is the value status.

Value:0 = The **Value** field shows the sensor status value.

For details on the **LASTVAL** command, refer to section LASTVAL Command on page 183.

2. For conventional sensors open the **Sensor Calibration** tab in MAWS Terminal, see Figure 84 on page 96. The list of the MAWS sensors is displayed in the tab. The **Status** column shows the sensor status. To read the latest sensor statuses and measurement values, click the **Refresh** button. Table 13 on page 97 describes the other columns in the **Sensor Calibration** tab.

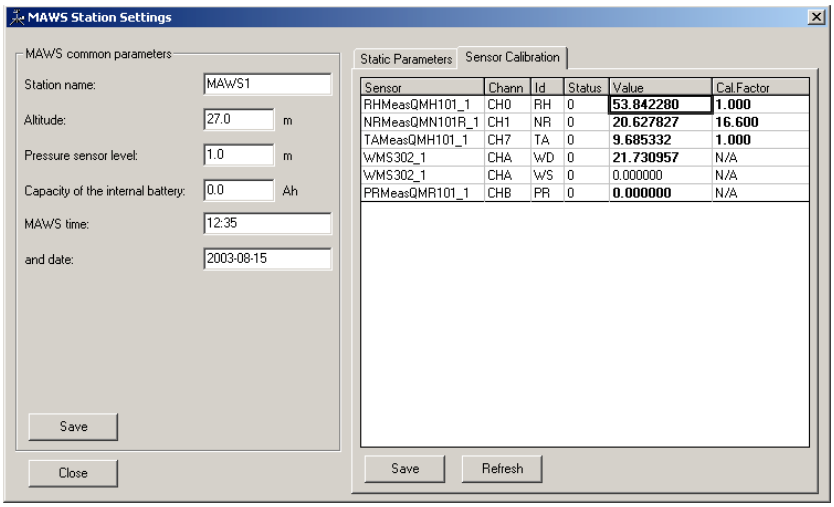


Figure 122 MAWS Station Settings Window: Sensor Calibration Tab

CAUTION When you upgrade a previous MAWS version to 3.06 or above, the following sensors will not operate correctly in the **Sensor Calibration** tab until they are removed from the setup and then re-created: CM6B, CM11, QMS101, QMS102, and QMN101.

NOTE You must load an appropriate setup to MAWS, before you are able to use the **Sensor Calibration** tab.

NOTE The **Sensor Calibration** tab is not visible for the setups made with the MAWS software versions prior to 3.06. With such an older setup, **MAWS common parameters** frame shows only the calibration values for the wind direction and solar radiation sensors, other sensors need to be calibrated through the terminal connection with the appropriate calibration commands.

NOTE When **Value** is expressed as `N/A`, it indicates that the calibration factor has been altered but not saved, the sensor has not been measured or the measurement channel of it has failed, or the sensor is disabled. Further information about the possible reason can be obtained by comparing the value in the **Status** column against the values listed in Table 14 on page 99.

Table 26 Columns in the Sensor Calibration Tab

Column	Description	Input
Sensor	The sensor name as defined in the setup.	n/a
Channel	The measurement channel of the sensor.	n/a
ID	The measurement identifier	n/a
Status	The sensor status	n/a
Value	The last measured sensor reading shown in physical units.	Overwrites the sensor reading with the entered value, that is, changes the offset of the measurement.
Cal.Factor	The measurement gain for the sensors, except for the radiation sensors (QMN10x and QMS10x) the sensitivity value.	Overwrites the old gain value with the new one. For radiation sensors (QMN10x and QMS10x) changes the sensitivity value.

Table 27 Sensor Status List

Value	Meaning	Notes
0	The sensor is working properly (OK).	
1	Not measured yet	
2	Interface is not initialized.	1
3	Communication time out has occurred.	1
4	Unknown data is received.	1
5	Communication is functioning, but the sensor reports errors. Use sensor's own service interface to find out cause.	1
6	Sensor communication is paused because service connection is opened through MAWS.	1
7	Message sequence numbers are overlapping in the Autotrac satellite transceiver interface.	1
8 ... 19	Not available	
20	Excitation failure is caused by the overload in the excitation output.	2
21	The input voltage is out of range or the A/D conversion has failed due to an internal error.	2
22	Sensor is disconnected or the connection cables are broken.	2
23	Sensor output exceeds the min/max limits defined in the **Measurements** view.	2
24	Change in sensor output has exceeded the maximum step defined in the **Measurements** view.	2
25	An internal configuration error has occurred.	2
26	Error in reference measurement, which is usually caused by damaged sensor/logger or electrical interference.	2
27	Internal voltage error occurred or the logger is damaged.	2
28	PMT16 calibration data error.	2
29	Data is invalid for unspecified reason.	2
30	The measurement or the sensor has been manually disabled.	
99	Sensor status is not supported.	

1. Value is available only for the sensors with the serial interface.
2. Value is available only for the sensors with a conventional, that is, analog or counter/frequency interface.

Using External Memory Card

The external memory card is used to store log files that have been copied or moved from the internal log directory. The data can be retrieved from the external memory card via terminal connection or by switching the memory card with an empty one.

Note that the memory card must be formatted with a command **EXTFS** *ERASE* before use.

When a new memory card is inserted into MAWS, the software checks that the card is ready for use. The status of the memory card is indicated by a LED. Table 17 on page 121 describes the different blinking sequences and the card conditions they indicate.

Table 28 LED Blinking Sequences and Card Status Options

Blinking Sequence	Card Status
Long-long	The card is OK.
Constantly on	Data is being written.
Short-short-short for 5 seconds	The card is unformatted or corrupted.

The external memory card can be removed from MAWS for data retrieval without interruptions to MAWS operations. MAWS copies data from the internal log directory to the memory card daily at midnight, the default time is 00:00:30. The data is being written, when the LED on the logger cover to the left of the external memory card is constantly on.

CAUTION The memory card must not be removed from MAWS while data is being written or the data may be lost. By default, data is transmitted to the memory card every day at 00:00:30.

Automatic Erase from External Memory Card

The log group specific setting **Number of days to preserve log files** affects also the files stored to the external memory card. The functionality is the same as for internal log memory, that is,

- Files older than the selected value [*days*] will be deleted automatically
- Files are not erased, that is, the automatic clean up is disabled

When files are stored to the external memory card, the internal memory is used as the working memory for storing the log files of the current day. These working files are moved to the external card each day just after midnight when the new files have been created for writing.

Commands for Troubleshooting Purposes

For most of the sensor inputs, there are data validation parameters to check the following measurement's quality parameters:

- Maximum value: the maximum climatological value for the sensor measurement.
- Minimum value: the minimum climatological value for the sensor measurement.
- Step change: the maximum step change for the sensor value between two consecutive measurements.

All of these parameters can be set by the user with the MAWS Lizard Setup Software. For more information, refer to the MAWS Lizard Setup Software User's Guide.

If the sensor value is outside of the maximum or minimum values, or it has altered more than the maximum step change allowed, then data will be flagged as INVALID. Invalid data is typically displayed as ///// (this is a parameter that user can set). If a sensor displays invalid data, this is an indication that the sensor is faulty or out of calibration, or there is a problem in powering or measuring the sensor.

LASTVAL Command

If the value in the report changes to ////, you can check the measurement's/sensor's value with the **LASTVAL** command. Give the command in the terminal connection. When you use the raw parameter, the measured value before any validation and the status produced during validation are shown. When you use the corresponding signal name, the validated value is shown.

LASTVAL [*Measurement*] [*raw* | *Signal name*]

where

Measurement	=	The name of the measurement as it is defined in the MAWS setup file.
raw	=	The parameter that gives the status and the value of the measurement before validation.
Signal name	=	The parameter that gives the validated value of the measurement.

Examples:

The command with the signal name parameter (in the following case `TA`) produces the following response:

```
/ > LASTVAL TAMeasQMH101_1 TA
Status:1  Value:20.490570
```

where

Status:1	=	The value is valid.
Value:20.490570	=	The validated value for the temperature measurement is 20.49xxxx

The measurement TAMeasQMH101_1 is defined in the setup file. The command with the raw parameter produces the following response:

```
/ > LASTVAL TAMeasQMH101_1 raw
Status:1  Value:20.490570
```

where

Status:1	=	The value is valid.
Value:20.490570	=	The raw value for the temperature measurement is 20.49xxxx

When the value in the report changes to ////, you can check the value. In the following case the probe is not connected:

```
/ > LASTVAL TAMeasQMH101_1 raw
Status:2  Value:-238.285549
```

where

Status:2	=	The value is invalid.
Value:-238.285549	=	The raw value for the temperature measurement is -238.285549, which means the probe is not connected.

When the value is invalid, check the sensor status value, and refer to Table 14 on page 99:

```
/ > LASTVAL TAMeasQMH101_1 status
Status:1 Value:0
```

where

Status:1	=	The **Status** field in the output is the value status.
Value:0	=	The **Value** field shows the sensor status.

Warnings and Errors

There may be some problems if you see either of these prompts:

```
/ E>
/ W>
```

`/ E>` means that there are errors and `/ W>` means that there are warnings.

It is normal to have one or two warnings after the serial connection to MAWS has been reset, for example, you have turned your PC off and so it is nothing to be worried about.

To see active warnings, type **warnings**. To clear active warnings, type **warnings** *clear*. Warnings indicate that there are some problems in the software.

Example:

```
/ W> warnings
Warning: Break
  occurred 9 times first in uart.cpp[84]
  during thread: 00019F60 [AbsTimerT]
  object pointer: 106C [component: COM0]
Warning: Frame
  occurred 14 times first in uart.cpp[83]
  during thread: 00019F60 [AbsTimerT]
  object pointer: 106C [component: COM0]
```

The `Break` and `Frame` warnings mean that most likely you have turned your PC off and on again. This causes no trouble and you can clear the warnings.

```
Warning: Device reset
  occurred 1 times first in c:/libs/MAWS/adcl/kernel/
idle.cpp[52]
  during thread: 00001694 [Idle]
  object pointer: 163C [component: Idle]
```

The warning above means that you have reset MAWS. This causes no trouble and you can clear the warning. If you have not reset MAWS and the warning still occurs, contact Vaisala technical support (see section Technical Support on page 198).

```
Warning: Data missing
  occurred 2 times first in h:/MAWS/software/adcl/report/
confrep.cpp[414]
  during thread: 00019C0C [AbsTimerT]
  object pointer: 33A94 [component: MyRep1]
```

If you receive this warning, check that **sname**, **pslevel**, and **altitude** are set.

To see active errors, type **errors**. To clear active errors, type **errors** *clear*. Errors indicate that there is something wrong with the sensors or configuration. Write down the error information and contact technical support.

System Information

You can acquire a report that contains system information by using the **SYSINFO** command in MAWS Terminal. The command lists parameters that are useful especially when troubleshooting the system or when contacting Vaisala HelpDesk.

Example:

```
/ > SYSINFO

Serial #         : 59289091
Hardware         : Rev F
Software         : 3.02    Checksum  : 61577576
System RAM       : 1024kB
Free memory      : 583kB
Internal temp.   : 3.13'C
Active errors    : NO
Active warnings  : NO
Piggyback - 0    : DSU232 rev: B serial no: 009513
Piggyback - 1    : N/A
Extension board  : QMC102 rev: B serial no: V37306
System uptime    : 65h 20min 27sec since Fri Jan 10 16:35:39
2003

/ >
```

where

Serial #	=	The serial number of the logger PCB.
Hardware	=	The hardware revision of the logger PCB.
Software	=	The software version for the operating software and it's checksum.
System RAM	=	The total amount of the memory on the logger.
Free memory	=	The amount of the free memory on the logger.
Internal temp.	=	The internal temperature of the logger.
Active errors	=	The existence of the active errors: YES/NO
Active warnings	=	The existence of the active warnings: YES/NO
Piggyback - 0	=	The type and serial number of the additional module installed in the module slot 1.
Piggyback - 1	=	The type and serial number of the additional module installed in the module slot 2.
Extension board	=	The type and serial number of the optionally installed memory expansion board.

System uptime = The total time that the system has been running, calculated from the last reset.

Battery Status

You can view battery status information by giving the command **battery** without parameters.

NOTE	The **battery** command applies only to the internal battery.

Example:

```
/ > battery
Remaining=100
State=FLOAT_CHARGE
U=6.850195
I=2.685547
Type=PB_BATTERY
Capacity=1.200000
Ext.DC=8.132420
Internal temperature=23.511668
```

Battery voltage (U) and voltage at the +ExtDC terminal are given as volts, charging current (I) as milliamperes and capacity as ampere-hours. The remaining percentage shows how much energy is left in the battery.

When is suspected that the internal battery or the charging circuitry is defective, try the following:

- Check that the battery capacity is correct and change it with **battery** [*capacity*] command, if necessary. If the capacity setting is too low, the battery simply charges slowly. In the opposite case, the battery may be damaged due to too high charging.
- Check the battery voltage, ExtDC voltage and charging current. ExtDC should be higher than battery voltage for charging. If it is lower, battery is discharging and charging current shows negative value. Normally, battery voltage should vary between 5.8 and 7.0 volts and it may rise as high as 7.5 volts during quick charge (for lead batteries).

Measurement Enable or Disable

You can manually enable or disable all measurement inputs and sensors. You can use this feature for example to:

- Change remotely the readings of a faulty sensor to be flagged as invalid.
- Mark all sensor readings invalid during the maintenance operation.

Use the following commands in the service connection to change the flagging:

enable <*Measurement Name*>

disable <*Measurement Name*>

where

enable	=	Enables the measurement inputs or sensors.
disable	=	Disables the measurement inputs or sensors.
Measurement Name	=	The measurement name from the **Configuration** view of MAWS Lizard.

NOTE For the sensors, that use more than one input channel, you need to enter separate commands for each measurement. For example, you need to control separately the TA and RH measurements of the QMH101 sensor.

Examples:

```
>\ disable RHMeasQMH101_1
>\ disable TAMeasQMH101_1
>\ disable WMS302_1
>\ enable PWD11_1
```

Upon successful completion of the commands MAWS return:

```
Successfully disabled
```

or

```
Successfully enabled
```

Any other returned values indicate an error.

When the measurement input is disabled:

- All other output values than status have undefined values.
- Sensor status shows `disabled`, refer to the updated list of the sensor statuses in Table 14 on page 99.
- Value status shows `INVALID` and `NOT AVAILABLE`.

Battery Regulator

Table 29 Battery LEDs

LED	Color	Explanation
Battery status LED	Green	Charging
	Blank	Not charging
Charge LED	Green	OK
	Orange	Low
	Red	DC off

Power Supply

Table 30 on page 189 lists some common problems of WHP25 and their remedies.

Table 30 Some Common Problems and their Remedies

Problem	Probable Cause	Remedy
No voltage between X5 and the grounding crimp.	Fuse F1 is broken.	Replace the fuse F1 as instructed in section Replacing Fuses on page 189.
No voltage from the 24 VDC output.	Fuse F2 is broken	Replace the fuse F2 as instructed in section Replacing Fuses on page 189.
No voltage from the 36 VDC output.	Fuse R3 is broken.	Send the unit to Vaisala for repair.

Replacing Fuses

Follow the procedure below to replace a broken fuse:

1. Remove the four screws attaching the cover of the WHP25 unit. Remove the cover.
2. Disconnect the power input.

3. Refer to Figure 123 on page 190 for the location of the replaceable fuses.
4. Open the holder of the broken fuse (either F1 or F2) with a screw driver.
5. Replace the broken fuse (either F1 or F2) with a new one and screw the holder back onto its place.
6. Connect the power input.
7. Carefully reattach the enclosure cover with the four screws.

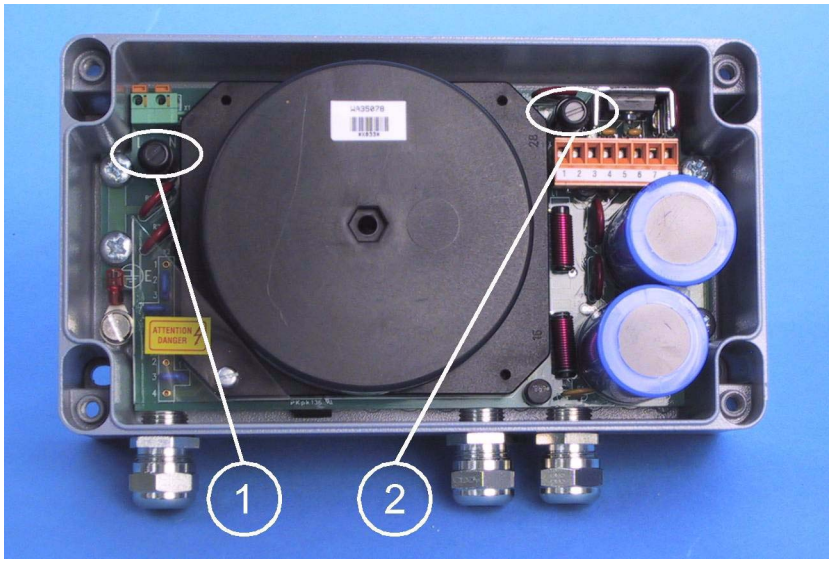


Figure 123 Location of the Fuses F1 and F2

The following numbers refer to Figure 123 on page 190.

1 = F1: 2 AT replaceable fuse, 5 × 20 mm

2 = F2: 8 AT replaceable fuse, 5 × 20 mm

Solar Panel

Table 31 Troubleshooting the Solar Panel

Problem	Probable Cause	Remedy
The power output has decreased.	The module surface is dirty	Gently clean it with a soft cloth or sponge using water and mild detergent.

GSM Modems

To test the GSM modems with the AT commands, refer to Table 32 on page 191. The faulty GSM Modems are not serviceable in the field; if they do not operate correctly, you must return them to Vaisala for repairs.

Table 32 Test Commands for GSM Modems

Parameter	Command	Value
Network registration	AT+CREG=?	Returns the available operators
Available operator	AT+COPS?	Returns the used operator
	AT+COPS=?	Queries all available operators, can be used to refresh the connection
Operator selection	AT+COPS=0/1	0=automatic, 1=manual
Signal quality	AT+CSQ	Receive level 31 = best 0 = worst 99 = not know,Bit error rate 0...7 99 not known

To monitor different command sequences, check the **Extra op. Info to COM0** option in modem configuration. This enables the modem control software to output various status information to the fixed RS232 port, that is, COM0. For example, you can monitor what is sent to the modem and how it responds. The printout includes additional internal debug data. Note that the output is sent only when the service connection is closed.

GOES Satellite Transmitter

The Satellite Data Transmitter is not serviceable in the field; if it does not operate correctly, you must return it to Vaisala for repairs.

Ultrasonic Wind Sensor

Table 33 on page 192 lists some common problems of WS425 and their remedies.

Table 33 Troubleshooting WS425

Problem	Probable Cause	Remedy
When the sensor is powered up it does not send any data, that is, no data is coming to the PC.	By default, the sensor is set to a command-response mode (polling mode). This means that the sensor is waiting for a data request command from the data logger.	To change the sensor settings, you need to open a maintenance connection to your WS425 sensor and configure parameter number 5, *Output Interval*, to have a non-zero value and the sensor will automatically send data through the serial line.

Combined Wind Sensor

Table 34 Troubleshooting Combined Wind Sensor

Problem	Probable Cause	Remedy
The data is not received from the sensor.	The sensor is mechanically damaged.	Check the cables and connectors.
	The sensor is not powered properly.	Check that the supply voltage is from 3 to 15 VDC.

Anemometers

Table 35 on page 193 lists some common problems of Anemometers and their remedies.

Table 35 Troubleshooting Anemometers

Problem	Probable Cause	Remedy
The data is not received from the sensor.	The sensor is mechanically damaged.	Check the cables and connectors.
	After removing the connector's hexagon nut, the connector is bent, which breaks the connection wires.	Check the connector.
	The sensor is not powered properly.	Check that the supply voltage is from 9.5 to 15.5 VDC
	Some Vaisala products, for example, WAT12, switch power on to the sensor only for a very short period (200 s to 500 s).	Check that the sensor output rises above (U_{in} - 1.5 V) at the end of the power pulse.
The sensor shaft is covered with ice and snow.	The heating element does not function.	Send the sensor to Vaisala for repair.
	The heating element is not properly connected.	Open the sensor and check that the heating element outlet is connected to the connector on the printed circuit board.
The output from connector pin C tracked with an oscilloscope is not square wave.	The printed circuit board is damaged.	Replace the printed circuit board or send the sensor to Vaisala for repair.
The frequency is not equal to 14 times revolution rate.		
Current consumption is more than 28 mA when the shaft is rotated mechanically.		

Wind Vanes

Table 36 on page 194 lists some common problems of Anemometers and their remedies.

Table 36 Troubleshooting Wind Vanes

Problem	Probable Cause	Remedy
The data is not received from the sensor.	The sensor is mechanically damaged.	Check the cables and connectors.
	After removing the connector's hexagon nut, the connector is bent, which breaks the connection wires.	Check the connector.
	The sensor is not powered properly.	Check that the supply voltage is from 9.5 to 15.5 VDC
	Some Vaisala products, for example, WAT12, switch power on to the sensor only for a very short period (200 s to 500 s).	Check that the sensor output rises above (U_{in} - 1.5 V) at the end of the power pulse.
The sensor shaft is covered with ice and snow.	The heating element does not function.	Send the sensor to Vaisala for repair.
	The heating element is not properly connected.	Open the sensor and check that the heating element outlet is connected to the connector on the printed circuit board.
The output from the connector pins C to H do not have the right code or are not at the proper level.	The printed circuit board is damaged.	Replace the printed circuit board or send the sensor to Vaisala for repair.
Current consumption is either less than 17 mA or more than 25 mA when the shaft is rotated mechanically.		

Wind Transmitter

Table 37 on page 195 lists some common problems of Anemometers and their remedies.

Table 37 Troubleshooting WT521

Problem	Probable Cause	Remedy
No service connection	Transmitter is not powered.	Ensure proper supply voltage for the transmitter.
	Improper cable	Check the cable.
	Transmitter is broken	Check that the green LED is blinking after supplying the transmitter. If not, return the transmitter to manufacturer for service.
No blinking green LED	Transmitter is not powered or the transmitter is broken.	As above
Green LED blinking slowly at 50% duty cycle	Transmitter is not powered properly	Ensure proper supply voltage for the transmitter.
	Internal system error	Return unit to manufacturer for service.
Red LED on	Transmitter is not powered properly	Ensure proper supply voltage for the transmitter.
Optional communication interface is not working	Improper or loose wiring	Check wiring and tighten screw terminals.
	Module missing	Plug in the module.
	Wrong module	Ensure that correct module option is used.
	Module broken	Replace broken module with a new one.
	Transmitter is broken	As above
Shaft heating is not working	Improper or loose wiring	Check wiring and tighten screw terminals.
	Heating is not activated	Open terminal connection to WT521 and give command **SETHEA 1**.
	Transmitter is broken	As above

Air Temperature and Relative Humidity Sensor

Table 38 Troubleshooting the Air Temperature and Relative Humidity Sensor

Problem	Probable Cause	Remedy
You receive no data.	Cable is not connected.	Check the cable connection.
The data seems to be incorrect.	The installation site is not correct.	Select a new location according to the installation instructions.
	The probe requires calibration.	Calibrate the probe according to the separate instructions.

Present Weather Detector

If the Present Weather Detector is not working properly:

1. The lenses may be excessively contaminated.
   - Clean the lenses.
2. One of the hoods has been filled with snow, leaves or other things.
   - Clean the hoods.
3. Check that there are no foreign objects in the sample volume.
   - Tree branches, loose cables, or any other moving objects in the sample volume may cause sudden changes in the scatter signal.
4. Check the power supply voltage.
5. Check that all the connectors are properly inserted.
6. Check the power cable and connections.
7. Check that there are no flashing lights close to sensor.
   - Flashing lights may cause sensor to detect peaks in the optical signal.

For more information, refer to Present Weather Detector User's Guide.

Present Weather Sensor

WARNING The equipment contains dangerous voltage of 230 VAC.

Table 39 Some Common Problems with FD12P and Their Remedies

Problem	Probable Cause	Remedy
The visibility value is continuously too good.	The lenses may be excessively contaminated	Clean the lenses.
	One of the hoods has been filled with snow, leaves or other things.	Clean the hoods.
	There is condensation on the lens surfaces. This is a sign of heating failure.	See FD12P User's Guide.
	Electrical fault in transmitter or receiver.	
Visibility is constantly too low.	Usually there is something disturbing the sample volume. Check the condition of the hoods.	If the hoods are slightly twisted, try to align them as much as possible. Contact Vaisala HelpDesk.
		Try to find better direction for the receiver/transmitter optics.
	Electrical fault.	See FD12P User's Guide.
FD12P reports precipitation when there is none.	Flashing lights may cause FD12P to detect peaks in the optical signal.	Check that there are no flashing lights close to FD12P.
	Tree branches or any other moving objects in the sample volume may cause sudden changes in the scatter signal.	Check that there are no foreign objects in the sample volume.
	If false detection has occurred in temperature above 0 °C, DRD12 does not function correctly.	Clean the DRD12 sensing surfaces thoroughly.
		Check the DRD12 operation.
FD12P reports frozen precipitation during rain.	The ratio of optical intensity measurement to DRD12 measurement is too high.	Check the optical calibration and DRD12 operation.

For more information, refer to FD12P User's Guide.

Ceilometer

If CT25K is not working properly, do the following:

1. Check the cable connections.
2. Check the presence and correctness of line voltage.
3. Check the operational states of the LEDs in the unit.
4. At the data line, check that the connection is correct.

For more information, refer to Ceilometer CT25K User's Guide.

Technical Support

When contacting Vaisala technical support, please send the following information with your technical enquiry or description of a fault:

1. Serial number of the MAWS logger.
2. The captured text of the **SYSINFO** command.
3. If you have modified the configuration file, and the the setup is possibly defected, please send also the captured *MAWS_Terminal.log* file and the configuration file (.dtg). Refer to MAWS Lizard User's Guide for instructions how to export a setup file.

For technical questions, contact the Vaisala technical support:

E-mail	helpdesk@vaisala.com
Phone (int.)	+358 9 8949 2789
Fax	+358 9 8949 2790

Return Instructions

If MAWS needs repair, please follow the instructions below to speed up the process and avoid extra costs. When the setup is defected, please send also the captured *MAWS_Terminal.log* file and the configuration file (.dtg). Refer to MAWS Lizard User's Guide for instructions how to export a setup file.

1. Read the warranty information.
2. Write a Problem Report with the name and contact information of a technically competent person who can provide further information on the problem.
3. On the Problem Report, please explain:
   - What failed (what worked / did not work)?
   - Where did it fail (location and environment)?
   - When did it fail (date, immediately / after a while / periodically / randomly)?
   - How many failed (only one defect / other same or similar defects / several failures in one unit)?
   - What was connected to the product and to which connectors?
   - Input power source type, voltage and list of other items (lighting, heaters, motors etc.) that were connected to the same power output.
   - What was done when the failure was noticed?
4. Include a detailed return address with your preferred shipping method on the Problem Report.
5. Pack the faulty product using an ESD protection bag of good quality with proper cushioning material in a strong box of adequate size. Please include the Problem Report in the same box.
6. Send the box to:.

   Vaisala Oyj

   Contact person / Division

   Vanha Nurmijärventie 21

   FIN-01670 Vantaa

   Finland

APPENDIX A
GLOSSARY

This appendix contains glossary with explanations of some general meteorological and technical terms and terms used in specifications.

Accuracy	The degree of conformity of a measured or calculated value to its actual or specified value.
Altitude	The station altitude in meters from sea level.
Atmospheric pressure	The pressure at a given point due to the gravitational force on the column of air above it. The official unit of pressure is Pascal (Pa = newton/m^2). The unit hectopascal (hPa) has been chosen to be used in meteorological barometric pressure measurement. 1 hPa = 100 Pa = 1 mbar
Barometer	Instrument for measuring atmospheric pressure.
Barometric pressure	See Atmospheric pressure.
Baud	The unit of signaling speed of a line, which is the number of transitions (voltage or frequency changes) that are made per second. The term has often been erroneously used to specify bits per second. However, only at very low speeds is baud equal to bps; for example, 300 baud is the same as 300 bps. Beyond that, one baud can be made to represent more than one bit. For example, a V.22bis modem generates 1200 bps at 600 baud.

Celsius scale	Temperature scale having the freezing point of pure water at 0 °C and the boiling point at 100 °C under standard sea level pressure. All the temperatures measured with MAWS are given in Celsius degrees.
Configuration	Set of instructions for the MAWS logger. The compiled configuration (a script) is in fact a program that runs in MAWS.
Crosswind	The wind blowing perpendicular to the course of a moving object.
Damping ratio	Describes the response of a wind vane to a sudden change in wind direction. It is defined as the ratio of the actual damping to the critical damping. Critical damping is that value of damping which gives the fastest transient response without overshoot.
Delay distance	The passage of air necessary over a wind vane to cause the vane to respond to 50 % of a step function change in wind direction.
Dew point (temperature)	The temperature at which the air, if cooled, would reach saturation, and at which dew would therefore begin to condense out on a solid surface.
Global radiation	The total of direct solar radiation and diffuse sky radiation received by a horizontal surface. Global radiation is measured by pyranometers.
Gust	The peak momentary wind velocity within a given interval of time, for example, 10 minutes.
Hexadecimal	Numbering system using the base number 16 and including the ten decimal digits (0 to 9) along with six alpha digits (A to F).
Humidity	The water vapor content of the air. Weather station sensors commonly measure relative humidity. Relative humidity is the ratio of water vapor pressure present in a gas to the maximum pressure of water vapor that could be present in the gas in that temperature.
LED	Light Emitting Diode
Logger	The processing unit of the MAWS system. The electronics of the logger take care of measuring, storing, and processing of the measured parameters.
Logging	The process of storing the measured and calculated values in the logger's memory.
Lull	The minimum of wind speed during a certain time interval.
Modem	A device that allows a terminal or computer at one location to communicate with a terminal or computer at a distant location via wire or telephone lines.

Precipitation	Term that refers to all forms of water particles that fall upon the earth. This includes rain, snow, and hail. It is the universal practice to distinguish between rain, snow, and total precipitation. Snow is sometimes measured as such and sometimes it is melted and measured as water.
Pslevel	The pressure sensor level in meters from the station altitude.
Pyranometer	An instrument that measures solar energy received from the entire hemisphere (180 degrees field of view). The output is expressed in Watts per square meter (W/m^2).
QFE	The actual atmospheric pressure at the level of station altitude or at the height of the runway threshold. The difference of the pressure sensor level and the station altitude (or runway threshold) is indicated by the pressure sensor (pslevel) setting in MAWS. QFE is normally used for aviation purposes.
QFF	The sea level pressure as QNH, but the value is corrected by the actual air temperature (or in some cases by virtual temperature, that is, temperature 12 hours ago). QFF is used in synoptical observations.
QNH (altimeter setting)	The atmospheric pressure at sea level in the standard atmosphere. The station altitude is indicated by station altitude setting in MAWS (difference of mean sea level and station altitude). QNH is used for aviation purposes.
Rain gauge	Measures precipitation based on depth, that is, the depth to which a flat surface would be covered if no water were lost by run-off or evaporation.
RS-232	Standard serial transmission protocol. A standard interface between a computer input/output port and a peripheral device.
RS-485	Standard serial transmission protocol. This protocol permits multi-drop networks (up to 32 nodes) using a single twisted pair cable.
Solar radiation	The solar energy received from the entire hemisphere. It is measured with a pyranometer.
Synchronizing time	Ties the operation to the clock for software operations. For instance, if an operation is always to be performed twenty minutes to the hour, the synchronizing time should be set to 00:40:00.
WMO	The World Meteorological Organization.
ZModem	File transfer protocol that is used when transferring files between MAWS and a terminal program.